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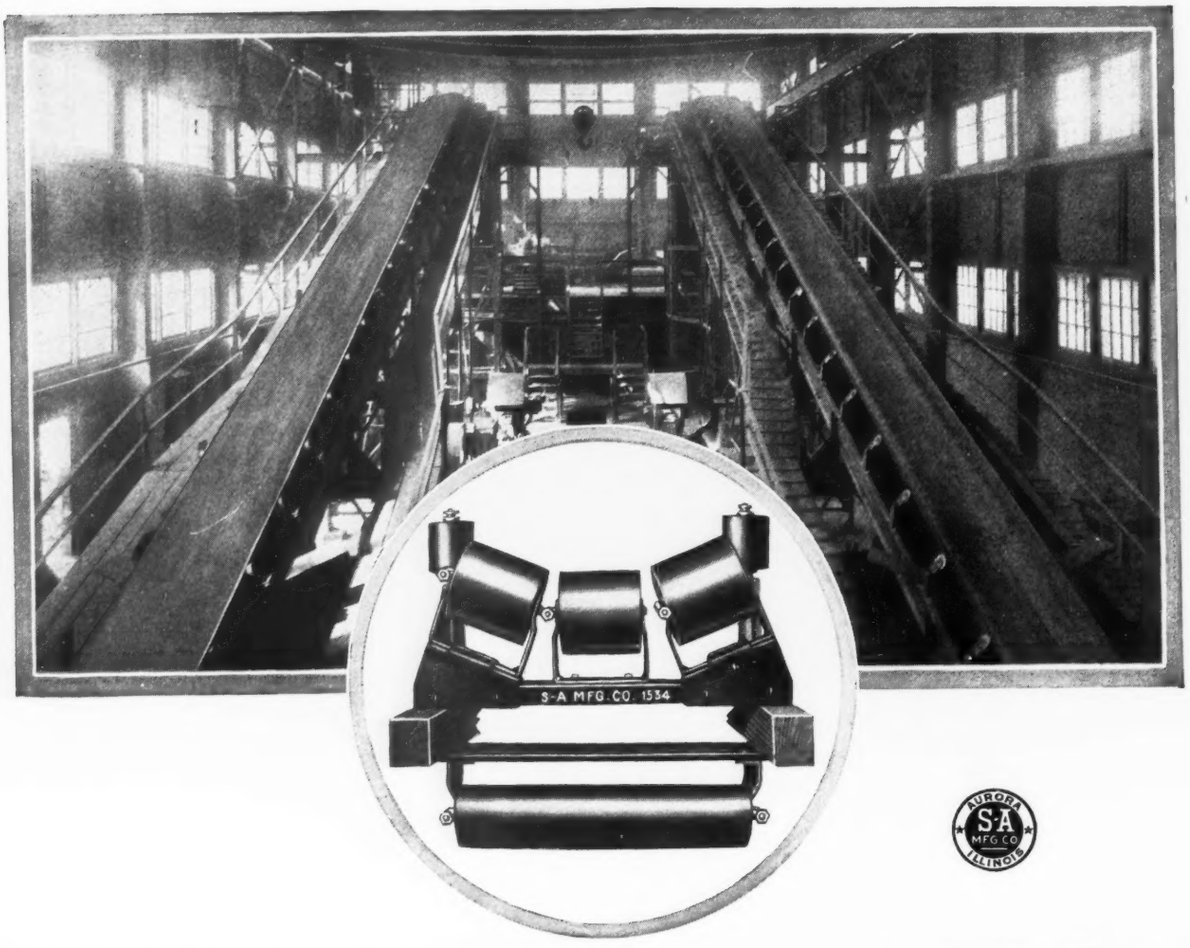
Petroleum Recovery by Mining—Its Possibilities, by John L. Rich

Mining of Hematite Paint at Clinton, N.Y., by W. S. Black

Treating Copper-Molybdenum Ores, by H. A. Doerner

A Journey to South Africa, by T. A. Rickard

Eliminating hand labor in a smelter yard. Excess receipts of Chino concentrates are stacked upon the ground at the American Smelting & Refining Co.'s El Paso plant. A locomotive crane and bucket are used for unloading and reclaiming them



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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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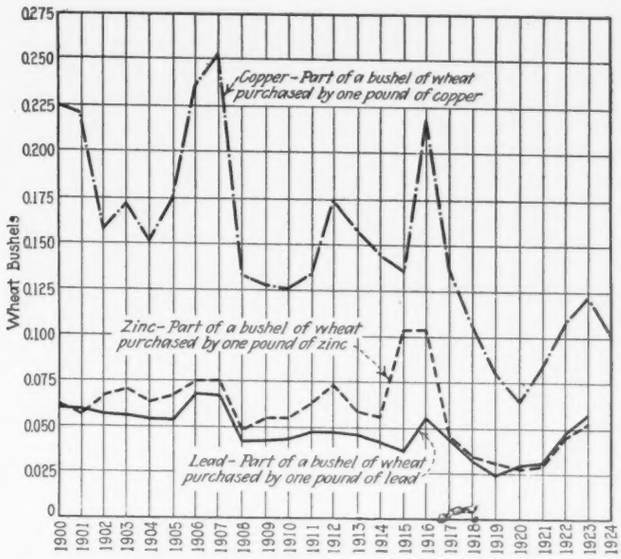
The Price of Copper in Terms of Wheat

THE INTERESTING and instructive article by William Spence Black in our issue of May 16 pointed out the fallacy of considering the price of copper in terms of the current dollar, and arrived at some clearer conceptions by reduction of prices to a standard basis—the 1913 dollar; showing thereby a steady decline in the price of copper over many years, in contrast to appearances that copper was holding its own.

Similar calculations were made some some months back by the *Mining Journal-Press* staff; but instead of figuring on a standard dollar, the basis to which copper prices were reduced was that of the most standard agricultural commodity—a bushel of wheat. This is not so good a basis for some reasons as Mr. Black's basis, which is a composite of the purchasing power applied to all commodities in a given pre-war year. In another way, however, it is interesting, even though in cutting loose from a fluctuating dollar it adopts another fluctuating standard. But it provides a comparison with a commodity more standard and significant than itself; it also allows a comparison between the chief unit of mine production and the chief unit of farm production.

As is evident from a glance at the graph, there has been a steady decline in the last twenty-five years in the ability of copper to buy wheat. With all the peaks and hollows representing the long swings, the secular trend is striking. During the same period lead and zinc, however, have nearly held their own in terms of wheat.

The results of this comparison are to strengthen the conclusion that real copper prices have a great momentum downward, and to support Mr. Black's conclusion that the cheapening of the cost of production is the reason. There are two causes for this striking secular lowering of cost: the first is that of greater technical efficiency, the perfecting of metallurgical process, involving the recovery of a larger percentage of metal; and the cheapened cost of mining, due to wholesale methods. But the latter factor, it must not be lost sight of, is dependent upon the sudden and closely successive discoveries of vast tonnages of easily mined and profitable copper, and in the end this is the prime controlling factor, without which the technological skill would have had only a minor influence, and which really has determined the secular lowering of the price of the metal. For the human race, this discovery of the porphyry copper deposits and their utilization, enabling an abundant supply of cheap copper, was a windfall, a piece of luck. Dr. N. M. Fenneman, in his vice-presidential address before the American Association for the Advancement of Science, in December, referred to these windfalls as "bonuses" to mankind, and rightly added that the petroleum of the world was the greatest bonus that mankind had ever had. The word bonus, it will be noted, is in contradistinction from wage, and indicates something not to be repeated. And in the same sense the porphyry coppers were a bonus, and we have cheap copper as well as cheap gasoline—for a certain period. It is quite evident that the copper bonus is not going to last forever, any more than the oil bonus,



and its course will be marked by the price of copper, as compared with wheat or some other standard. If anyone feels like laying up treasures for his children, it would appear that there is nothing safer and surer than to buy a copper mine containing a large tonnage of copper that will not quite pay for working under the present conditions; pay the taxes, and forget about it; and for corporations, which have no demise, the same forward-looking policy might be considered.

Sillimanite as a Refractory

SENSATIONAL REPORTS recently appeared in the New York press announcing the acquisition by a certain importer of a deposit of sillimanite in India, 100 miles west of Calcutta—"the only natural deposit of sillimanite in the world large enough to be of economic importance," it was stated. "Kyanite, not sillimanite," said London comment. But whether sillimanite or kyanite, publicity regarding sillimanite continued. "Sillimanite the ideal refractory" and similar phrases have found their way into print. So it has seemed worth while to seek information on sillimanite from some of those engaged in the refractory trade. "What do you think of it for refractory purposes?" we asked.

Sillimanite is more refractory than the highest grades of fireclay, one important manufacturer replied. It seems to have a higher fusing point than most other refractories consisting essentially of silica and alumina, but, when made up into brick, apparently has counterbalancing disadvantages, because of its other properties, such as a tendency to spall and its thermal expansion.

It has been made synthetically in the laboratory and in some cases on a slightly larger scale, but never in commercial quantities because of the difficulties mentioned. Cost of production has naturally been exceedingly high.

The difficulty of securing a suitable bond and making passable brick with either natural or synthetic sillimanite has been and still is another difficult problem. The brick thus far produced, in the manufacturer's opinion, has been far from being equal to sillimanite itself as a refractory. The addition of other materials to secure the proper physical properties in the finished brick results in a product that is inferior to the mineral itself.

It would seem, therefore, if these observations be correct, that even the discovery or acquisition of a large deposit of sillimanite would leave the finder or purchaser with a difficult problem to solve before he could take a profit. Blocks or bricks, cut or sawed, of the natural mineral, if pure, might possibly be used to advantage for refractory purposes, if transportation conditions permitted. The cost of such a method of preparing for market would be another matter.

Government Dams for Hydraulic Mines?

THE frank and constructive article on the hydraulic placer problem of California, in our issue of May 16, by Major H. A. Finch, of the California Debris Commission, demands careful consideration by the people of California and of the country. In saying this we are expressing neither our approval nor our disapproval of the remedy proposed—the government construction of tailing dams, the cost to be gradually reimbursed to the government by periodical payments by the beneficiaries, on the same general principle as government irrigation projects. Anything that savors of the participation of the government in business is against the instinct of the American people; nevertheless, in some cases where it has been done, unqualified success has been the result. The reclamation system of the government is one case; the entry of the government into the express business through the parcel post system is another. But in the case of this proposal of Major Finch, the plan would have to be investigated by a qualified mixed committee of mining engineers, civil engineers, and financiers before it could be passed upon and a definite stamp of approval or disapproval given.

The reason for giving this suggestion especial consideration is more underlying. The gold reserves of the United States have dwindled greatly, the gold production is shrinking yearly. The country and the world can ill spare any unmined treasures of gold; and if it can be mined at a profit, American industry can ill afford this loss. But, as Major Finch points out, the growing intensity of agriculture is yearly making any production of this gold more difficult; and if anything is to be done, it should be done before too much time has elapsed. At least, study and appraisal of the problem and of the plan should be made immediately, in order to determine once for all whether a profitable solution is possible. We recommend this to the attention of the California legislature; to the Committee on Mines and Mining of the Senate; and to other organizations that are concerned with the future gold supply and the welfare of the mining industries.

In Passing

BAD NEWS for high-graders is the announcement that physicists of Leipzig can now detect hidden metallic objects carried by workmen as they check out when work is done. By their invention, they allege, all who leave the premises can be examined without physical contact, simply by walking through a door where an electrical field is generated. Tools, small parts, and nuggets or other metal objects, carried through the doorway, cause an alteration in this field that is at once made manifest by suitable apparatus. An adjustment can be made, it seems, to let watches, keys and other pocket things be taken out unheeded. Suspects can then be further searched by means of a small coil that is passed about the person.

The idea is interesting and no doubt has possibilities. Search your employees the electrical way; it removes the personal sting; it will cut down the turnover and increase the profits. A fit subject for a scenario—"The Fatal Door." Dinner buckets may present an obstacle; being of metal, these well-known vehicles for moving high-grade ore will disturb the electrical field, though empty. This is a minor problem, though, that the efficiency engineer can solve. Thus the workman must perforce be honest, thanks to the German physicists. Now if the German psychologists can but devise a mind-reading device that will reveal dishonest intent of executive or promoter, the interest of stockholders will be doubly guarded.

Spring and the Prospector

WHEN THE ICE BREAKS UP on the Northern rivers something breaks up in the blood of the prospector also; and a strong tide sets in through the heart which impels him to get ready his camp outfit and have his boots oiled and repaired. There are still plenty of fields in the North that have been explored very little, if at all; and there the bright beacon of possible success and certain adventure burns. With canoe, fish lines and gun, with pick and hammer and bacon and flour and mosquito netting, he plans an excursion and a royal hunt. This is the noblest of all sports—a sport that requires courage and endurance, but does not have as its object stupid and primitive slaughter—success is crowned by an addition to human resources and comfort, by applause and wealth, and all good and proper things. The ore hunter does not, like the game hunter, employ only those instincts which he shares with the wild animals, which do the job much better than he; his brain is busy with problems of geology, with ruminations on iron cappings, leached zones, ore-canals, intrusive areas, and all the rest of the guides whereby he continues to avoid the hopeless waste of his time, and confines his stalking to the areas where his knowledge assures him it is possible to find it. And find something he usually does—he returns with a bag—a bag of samples from which he can get assays; and if he does not encounter an outcropping bonanza, he has certain good showings which might look better if more of the outcrop were uncovered, or if the vein were exposed by hard-rock work.

When the autumn comes the rivers skim over with ice and slowly harden; and the hibernating instinct steals through the blood of the adventurer as well. He thinks without regret of going to some town or some comfortable mine and digging in for the winter; and

passing the blizzard days smoking in his bunk or reading by the stove, and ruminating over the glories of the unsuccessful hunt of last year, and of the hopeful territory which he will visit when the ice breaks up.

Spring indeed accounts for more in the way of events than we always know. It has been pointed out that with only one exception—the second war with England—all of the wars declared by the United States have been in the merry month of May. The martial spirit of adventure glows easily in May; and the long-buried instinct of ancestors bids one go forth to adventure.

Romance and the seasons are one of the elements of the mining problem, for the crowd as well as for the trained campaigner. Weave a romance about a mining investment and many a gallant from New York and London rushes to join the expedition. Tell a sober story replete with fact and good sense, and statistics about the dead and wounded, figuratively speaking, in many former mining ventures, and your gallants close their pocketbooks and go fishing. Hence the often-berated fact that the imaginative and often irresponsible promoter can lure plenty of capital from its holes, while the conservative, sober and too often pessimistic engineer cannot loosen a dime.

Advice on Mining Investments

LETTERS frequently come to *Mining Journal-Press* asking for our opinion of the stock of such and such a mining company as an investment or speculation. Sometimes we can give a helpful reply, where the mine and management are well known to one of the editors. More often, perhaps, the property is an obscure one of which we have merely heard, casually, and about which we know nothing on which to base an intelligent opinion. This brings up a very real difficulty that intending investors must meet. Mining prospects need money for their development; this money must be raised from the public, but the public requires, or at least should require, more evidence that its money is to be expended wisely than is furnished by the promoter or broker trying to sell the stock. To whom shall the intending investor turn for advice?

If one is to put a large amount of money into a mine, the best method is to secure the services of one or more competent mining engineers, and have them examine the property and report. The small investor cannot do this, for obvious reasons: he can ask his friends, write to a publication that he thinks may know something of the matter, or write to the state mining bureau in whose jurisdiction the property is situated, for an opinion. Sometimes the Chamber of Commerce in a neighboring city can give helpful information. None of these alternatives is altogether satisfactory: the information may be prejudiced, or it may be supplied, as it so frequently is, in newspaper replies, with no adequate knowledge of the facts. For instance, some one asked the *Wall Street Journal* recently about Alaska Juneau, and its possibilities as an investment. That paper, in its "Answers to Inquiries" column, replied with a brief statement of earnings and added the following comment: "It has been handicapped in the past by the remoteness of its mines and the consequent high cost of labor and material." Nothing was said about the fact that it mined 87c. ore last year. Even with that low grade, it made an operating profit of close to half a million dollars, so it would not seem to be greatly handicapped by the reasons cited. In fact, few mines are more accessible or have a lower labor cost than Alaska Juneau.

In New York City there is a worth-while institution known as the Better Business Bureau, which investigates the standing of various organizations with headquarters in the city and gives free reports to inquirers. This bureau is financed, we understand, by the business men of the city who wish to protect the public against fraud and see that every one gets a square deal. Something of this kind might be done for the mining investor; by whom it might be done is a matter on which we hesitate to venture an opinion. Perhaps there is an opening here for an experienced mining engineer or group of engineers, with a wide knowledge of the various mining districts of the country and with an impeccable reputation for honesty. Opinions on the prospects of a mining promotion might be given for a small fee. In cases where there was sufficient public interest in a property, the engineer might be justified in making a personal and thorough examination of the property, its management, and method of promotion, giving a more complete report than would otherwise be possible. Such a report would have to be copyrighted to prevent it from being reprinted with ulterior motives. Even though a property were merely in the first stages of development, an adverse report would not necessarily be indicated; but the speculative nature of the project would be clearly shown. The mining industries would appreciate a service of this kind, for it would tend to make more money available for the honest development of prospects, without which there can be no mines.

Pseudoscience and Impostors

SCIENCE has its uses, as the charlatan can tell. Its products, its terms and phraseology can be counterfeited, however crudely, and among the ignorant and unthinking the spurious will generally pass for true. Just as with members of a certain cult the human body has its astral counterpart, so many a useful device and theory has its asinine imitation that helps its tricky maker gain his evil ends. Once the witching stick or divining rod sufficed the fraudulent "prospector" for his deceptions, but, as his audience became sophisticated and gained a glimmering of science, a more complex device was needed, and the doodlebug with its mysterious nose for ore was born. To the uninitiated, this nonsensical piece of "apparatus," of varying appearance, seems little different from the torsion balance, the galvanometer, the potentiometer or other legitimate electrical prospecting device.

Another thing that long has kept its hold upon the popular imagination is radium, and this fascination has been exploited fully by promoters in many different ways. Sometimes these ways have been harmless, often mean, particularly where they hold out hope of cures. Construction of an artificial "radio-active spa," the first of its kind and not many miles from New York, has recently been announced in the daily news. Fifty tons of radium-bearing ore from a western point has been unloaded, and more is expected later. The plans call for construction of artificial springs and a pool on a lasting basis, it is said. The water, which is to be used for drinking and bathing, in flowing over the mineral will carry away radium emanation and will continuously be recharged and thus kept radio-active. "The ore is guaranteed to retain its radio-active powers for 3,000 years," the paper states.

A Journey to South Africa

From Vancouver to Cape Town

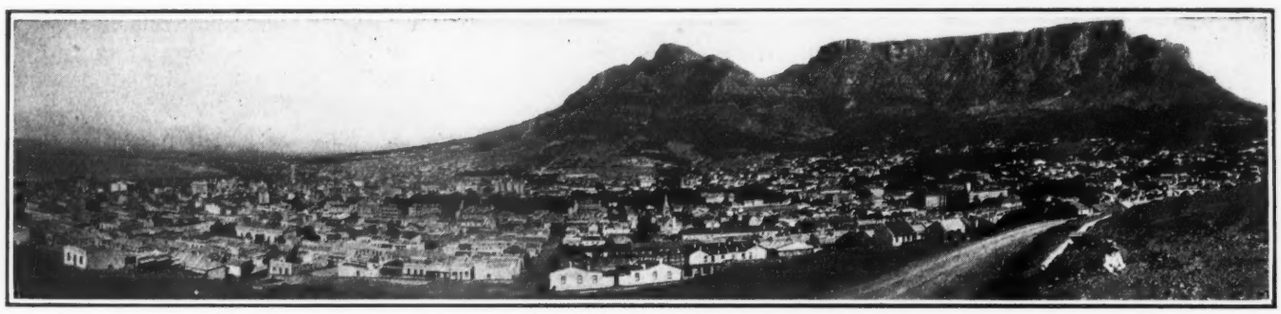
By T. A. Rickard

CAPE TOWN, APRIL 5—My journey began at Vancouver, B. C., because I had to attend a meeting of the Canadian Institute of Mining and Metallurgy before taking the transcontinental train to New York. As usual, I found contact with my Canadian friends to be most enjoyable. The people of British Columbia, I venture to say, have three agreeable characteristics: they say "thank you"; the women have well-modulated voices; and the men offer you a drink. These, I insist, are the marks of a highly advanced civilization.

On the evening of Feb. 19, after delivering a lecture on "Mining and Civilization," I took the boat for Seattle, from which city the next morning I started for New York. The distance is 3,315 miles, and it was done in exactly four days, less the three hours difference in longitude. To one who has crossed the American continent many times the journey is boresome, particularly in winter, when the landscape lacks verdure. The view from the car window was usually dispiriting, especially when crossing the wind-swept prairies of Montana and South Dakota. Among the remarks made in the smoking-room, I note the question, from an apparently intelligent man, as to what language was spoken in Australia, and the surprise of another when I told him that there were seven English-speaking nations. Apropos of this, I may tell the story of a distinguished Australian, who was dining at one of the colleges at Oxford. At the close of the dinner, the presiding Don proposed the toast, "England takes wine with her colonies." The Australian rose, and, with a touch of sternness, replied: "The self-governing Dominions of the British Commonwealth of Nations take wine with the Mother Country." Enough said!

On arrival in New York, the first thing to be done was to obtain a passport and the various visas. Our government no longer asks for evidence that the citizen's income tax has been paid before his departure; Mr. Hughes, as Secretary of State, having decided not to treat us as if we were absconders. The passport fee is $10, the British visa $10 more, and that for the Belgian Congo is $12. The country last mentioned also requires a doctor's certificate of good health and a statement of the traveler's respectability. The last I was able to obtain most pleasantly, from the Belgian Consul himself, because I bore the same name as my cousin, Edgar Rickard, who has been so prominent in the good work done by our people on behalf of the Belgians, in connection with the Commission for Relief in Belgium, under Mr. Hoover's leadership.

Not having been in New York for six years, I was prepared for a first impression, but I found it only more so than ever. It is more crowded than ever, and its avenues of communication seem to be more congested, despite the money and ingenuity spent on the problem of transportation. The tremendous motor traffic on Fifth Avenue and the other main arteries is controlled intelligently, but, despite much skill, the delays are frequent and annoying. At night the brilliantly lighted skyscrapers are imposing, and in the light of day the architectural effects down town are impressive. By a recent regulation, the tall buildings must not be built with an unbroken front; they are built in a series of stories, staggered, with a result that enhances their mountainous appearance. To one coming from a quiet university town in the West, New York seems intensely noisy, crowded, and assertive. It is a superbly arrogant expression of the material phase of our modern civilization. On the whole, I agree with Tom Dixon, who said, many years ago, "The stamping-ground of the great herd is no place for a man to live." Think of an immense herd of buffalo stamping the ground, raising the dust, and bellowing to high heaven. That is New York!



Cape Town, nestling at the foot of Table Mountain, as seen from Signal Hill

The Atlantic was crossed on the "France," of the Campagnie Générale Transatlantique. This French liner is a vessel of 23,000 tons, a beautiful ship, well equipped, and with a cuisine that leaves nothing to be desired. When the bar was opened as soon as we crossed the three-mile limit, I did *not* take a drink, because I did not happen to want one, but the Grave and Medoc that were served with the *dejeuner* and *diner* were both sound wines of about four years of age. It did not take long to realize that we were on French soil, as it were. French ideas were ventilated, and I was glad to receive them with mental hospitality. The French insist that the English are too lenient with Germany for the sake of resuming trade; the English, they say, are prone to forgiving their enemies and forgetting their friends; the Germans, they insist, are arming; they look forward to retrieving their dominance, and their republican form of government is a pretence. The French continue to talk of war, and rumors of war, as a matter of course, with a spirit that

seems strange to one coming from our West, where we seem to be trying to forget the fact that civilization went so close to the edge of the abyss only a few years ago. Our French friends insist that a partition of Germany, like that of Austria, should have followed the defeat of the German armies; the northern, or Protestant, Germany should, they say, have been separated from the southern, or Romanist, Germany. It was not done, they suggest, at the behest of the great commercial groups in Britain and the United States. As to us, they think we failed to finish our task: "We had an unequal fight with the Germans; you came to help us, and then retired; why save us only to let us perish later?" Even the premature settlement by the British of their debt to the United States is imputed to the bankers, to the *haute juiverie internationale.*

When political affairs seemed distressful, I shifted the talk to metallurgical business. It was suggested that a large copper refinery ought to be established in France. Two small ones are in operation. One is at Dives, near Caen, in the department of Calvados, and on the shore of the English Channel, not far from Havre. It is controlled by the Société d'electro-metallurgie de Dives. This plant was built by Secretan, notorious in connection with the attempted copper corner, known as *le krach de cuivre,* in 1889. Dives makes no cathodes, only semi-finished products, such as tubes, by means of the Elmore electrolytic process. A rolling-mill for copper and brass is included; also a wire-drawing plant. The capacity is about 1,000 tons per month. The blister copper is bought in New York. A trial shipment of 200 tons of copper is on its way to Dives from the United Verde Extension mine, in Arizona, by way of Los Angeles and the Panama Canal.

The other French refinery, controlled by the same company, is situated near Limoges, in the department of Haute Vienne. This enterprise is named La Société Hydro-electrique et Metallurgique de Palais, the last word signifying the location of the plant. It is an electrolytic refinery, according to American practice, but on a small scale—namely, 14,000 tons of fine copper per annum. It is proposed to increase the capacity shortly. The copper treated here comes from the Bor mine, in Serbia, a property controlled by the Banque Mirabaud, which also controls the Boleo mine in Lower California. The Bor is producing from 7,000 to 8,000 tons per annum, and is expected soon to increase its output to 12,000 tons. The Boleo refines its own copper at Santa Rosalia. Copper comes to Palais also from the Naltagua mine in Chile, and from the Belgian Congo —namely, the Union Minière mines in Katanga. The Palais refinery was built during the war, on the initiative of the French Government; the managing director is Richard Cardoza. Another small refinery was built and operated during the war at Pauillac, on the Gironde, near Bordeaux; but it is idle now. The government surrendered its interest in the plant to the group known as Minerais et Metaux. The capacity is 6,000 to 7,000 tons per annum. The plant, which was working so lately as last year, was built in 1917, and was supplied with copper from the Braden mine, in Chile, and also from sundry mines in Mexico.

In 1924 the imports of copper into France were 125,000 tons. The electrification of the French railroads has barely begun, and it promises to assist the copper market in the near future. In January of this year 20,000 tons of copper was purchased for trolleys.

The new refinery of the Union Minière company, operating the great copper mines in the Congo, is being built at Hoboken, near Antwerp. The capacity is to be 40,000 tons per annum, and the cost of the plant is estimated at $2,500,000. It is planned to treble this capacity in due course, the production being anticipated at 300,000 tons of copper annually within the next five years. The cost of production at present is between 9 and 10 cents per pound. About half the output (189,000,000 lb. last year) is going to the Nichols Copper Co., at Laurel Hill, N. Y., and most of the remainder to the Nord Deutscher Affinerie, at Hamburg, which is controlled by the Metallgesellschaft and Aaron Hirsch, the old metal octopus which spread its tentacles so wide before the war, and is securing a good grip once again.

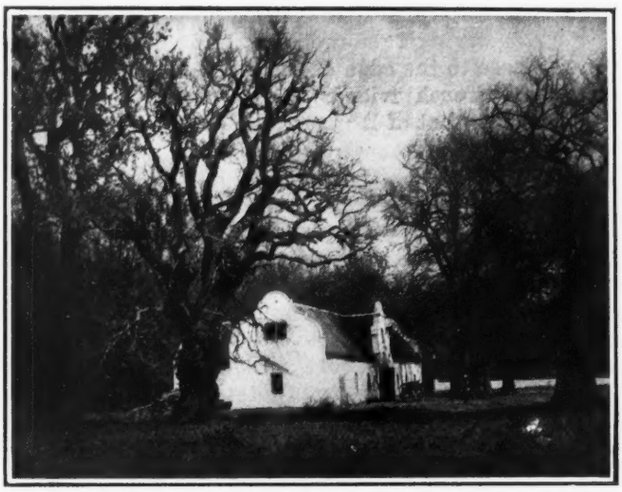
The Rhodes Memorial. The bust and inscription are inside the colonnade; in front is the bronze statue, by Watts, of "Energy"; in the background is Table Mountain

While in New York we three were inoculated against typhoid, this consisting of three injections, a week apart. It "took" in an unpleasant fashion, causing a little fever and much discomfort; but it was a wise precaution, because we shall not have much choice as to the water we shall have to drink in Central Africa. We arrived at Plymouth, after a remarkably quiet crossing, on March 6. *Nous avons fait une belle traversé.* The country through which we passed on the railroad to London showed signs of spring; as always, it looked trim and neat; 'tis a fine old land, which "fate and some fostering star have made so great." London seemed poorly lighted after New York, but wonderfully orderly. The first visit to the City, and to my old haunts near London Wall, left a somber impression. The people looked serious and sad, I thought, and their clothes seemed dull, if not shabby, as if thrift were compulsory. I seemed to see many old men with tired faces. Indeed, England has been hard hit, but it has faced the music bravely, not only during the war but in the trying times of peace-making. The cost of living is high, on account of high wages and short hours. For example, the shipbuilding industry is suffering in competition with the Germans, because in Germany the men work for 55 hours per week and 35 shillings, as against 48 hours and 55 shillings in England. The mining business is dull, except for a boom in platinum shares, based upon discoveries of that rare metal near Lydenburg, in the Transvaal. The Bingo and Davidson fiascos have hurt Canadian mining, both of these mines, in Ontario, having been the subject of exaggerated estimates, based upon inadequate or improper sampling. Many of the consulting engineers in London are idle, and new flotations are made with difficulty, either because the public has become less gullible, or is too poor to participate. Nevertheless, the old, fine spirit of adventure is still alive, and one hears of new copper mines in India, gold mines along the Congo-Nile divide, and fresh tin enterprises in the Malay States.

We sailed from Southampton by the "Saxon" on March 13, a Friday, and arrived at Cape Town on March 30, exactly on time. The distance is 6,000 miles. Cape Town is in the same longitude as Vienna, so we voyaged east as well as south. The only stop en route was at Funchal, on the island of Madeira, a Portuguese possession. The one thing worth mentioning is the method of transport, in sleds fitted with steel-shod runners and pulled by a pair of bullocks.

I saw Cape Town first through a port-hole in the early dawn. A beautiful sight! The city nestles under the protection of Table Mountain. The scene reminds one of Toulon and of Guaymas. The peculiar shape of the mountain is due to the unequal weathering of beds of sandstone and quartzite resting upon granite. We drove to the Mount Nelson Hotel in an Oakland car, which seemed very near home! Indeed, most of the automobiles are of American manufacture, and many other things besides, such as socks and shoes. On the other hand, the newspapers give no American news whatever. The only mention of American affairs that I saw during our stay of four days in Cape Town was a paragraph concerning a matricide in San Francisco.

After sending some cablegrams, we strolled down a wide path shaded with trees, into the town, past the university, Government House with its fine hedge of blue plumbago, and the House of Parliament with its statue of Queen Victoria. It was as hot as Sacramento in June or Phoenix in May. One notices the large



A typical Dutch farm-house of the best kind

numbers of natives and half-breeds. The population of Cape Town consists of 90,000 whites and 125,000 colored. The inter-breeding, for two and a half centuries, has produced a decidedly mixed population. In the Transvaal the marriage of whites with the aboriginal races is illegal; in Natal they are kept separate; but in the Cape Colony miscegenation is common. The results are unfortunate.

On landing, I noticed the sign "No smoking," and underneath it was the Dutch equivalent, "*Niet roken.*" This is a bilingual country. All the notices and railroad time-tables are printed in two languages. The records of Parliament have to be printed in English and High Dutch; but the language of the Dutch people in South Africa is not High Dutch; it is a Low Dutch mixed with Kaffir and English, a dialect known formerly as the Taal, and recently named Afrikaans. It is proposed now to use this debased dialect as a substitute for High Dutch, which few of the Boers understand, in the proceedings of Parliament.

I went to a sitting of the House of Assembly, and heard speeches in four tongues—namely, High Dutch, Afrikaans, literary English, and illiterate English. The Speaker read each motion first in English and then in High Dutch; the prayer at the opening of business is recited in English one day and in Dutch the next. Many of the members do not understand the speeches of their fellow members, on account of the difference in language. It is an absurd anomaly. Afrikaans is not a literary language; it has no dictionary as yet, and therefore anyone who is not bilingual is completely deprived of access to the records of human thoughts; he is mentally isolated from modern civilization. The only thing to do with Afrikaans it to let it alone, in which event it will die out, but, unfortunately, it survives as an expression of Dutch-African solidarity.

We went to Cape Point, to the Cape of Good Hope, the very end of the African continent, 51 miles south of Cape Town. On our way back we passed the cottage (at Muizenberg) where Cecil Rhodes died, and visited the park around his house at Groote Schuur, on the north slope of Table Mountain. Above the house is a place where he used to sit and look northward, dreaming of empire. There a memorial has been erected, and upon it is inscribed: "To the spirit and life-work of Cecil John Rhodes, who loved and served South Africa." His spirit broods over the vast region, and his work survives on every hand, as my next letter will show.

Possibilities of Petroleum Recovery by Mining

How Variations of Methods Used Abroad Might Be Applied in Fields of the United States—The Expected Cost Compared With That of Flooding

By John L. Rich
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WHENEVER the question of available oil reserves of the world is considered, the following facts suggest striking possibilities: According to widely published estimates, about 80 per cent of the oil originally contained in the average oil sand remains unrecovered after the sands have been exhausted by the usual pumping methods.

In Alsace, France, mining methods applied to an "exhausted" oil pool yielded in three years 2.4 times as much oil as had been pumped from the wells in the same area in ten years. Only about 17 per cent of the original oil content of the sand had been recovered by the wells, though many of them were "gushers" when first drilled.

In eastern Kansas and Oklahoma, as well as in a number of other localities in the United States, are numerous oil pools at depths ranging from 100 to 1,000 ft. whose yield is now nearly down to the economic limit for the usual pumping methods. A low percentage of recovery in these fields might be expected, because gas pressure, which is considered to be one of the chief forces acting to drive oil into a well, is low in most of these fields, and in many of them always has been low. Drillers' logs show 10 to 50 ft. of "pay" sand. An acre-foot of sand of 20 per cent porosity is capable of holding 1,550 bbl. of oil. Many of these pools have produced only 2,000 to 5,000 bbl. of oil per acre, or the theoretical capacity of from 1½ to 3½ ft. of sand. In view of these conditions, is it not probable that these old pools contain an enormous reserve of oil which could be recovered by mining methods such as those now in successful operation in France and Germany?

Such were some of the considerations which led a group of which I was a member[1] to undertake a study of the possibilities of recovering this oil by mining methods and the testing, by means of core drills, of a number of shallow oil properties in eastern Kansas to determine their oil content and suitability for mining.

In this paper are presented a brief résumé of European mining methods; possible variations of those methods which might be applied to the fields of the United States; a rough estimate of the expected cost of oil recovery by such methods as compared with the cost of recovery by "flooding"; with the results of the Kansas core tests and their bearing on the problem under discussion.

The production of petroleum by mining methods has been practiced in a small way in several European countries for more than a hundred years, but it was only during and since the World War that modern mining methods were employed and the problem was attacked on a commercial scale. Inasmuch as the methods and results of oil mining in France and Germany have been the subject of a number of recent papers[2] they are here given only in outline.

Briefly, the practice is to sink a shaft to the oil sand and from it to drive tunnels, or galleries, out into the oil sand itself. In Alsace, these galleries are driven in a roughly rectangular pattern with parallel entries about 320 ft. apart connected by crosscuts about every 165 ft. The oil seeps into these galleries and is carried by ditches in their bottoms to central sumps from which it is pumped to the surface. Seepage into the galleries is active when they are first driven, but within a few weeks or months it usually becomes negligible, though locally it continues at a profitable rate for a year or more. Such seepage is the principal source of the oil, though a small additional amount is recovered from the sand removed in driving the galleries.

In Alsace, the average yield from an 8 to 10-ft. sand has been 20 bbl. per linear foot of gallery. This, however, in three years, amounted to 2.4 times as much oil as had been recovered from the same area in ten years of pumping.

Special precautions are necessary to prevent ignition of the highly inflammable petroleum vapors which issue with the oil. Explosives cannot be used in mining; digging is done by pneumatic picks, which do not cause sparks, and hauling by unshod mules. For lighting, electric battery lamps have been found best. Further precautions are required to prevent the spread of any fire which may occur. Bulkheads and fire doors are built at intervals along the galleries, and parts of the galleries near the shaft are lined with masonry or concrete.

Timbering is usually necessary, and this is a further source of fire hazard, on account of its liability to become oil-soaked and because of its capacity for absorbing inflammable petroleum vapors. To avoid this hazard as much as possible, the oil ditches are inclosed and covered with sand, and strips of sheet iron are placed between the timbering and the walls of the galleries.

The mines are ventilated by powerful fans which force a strong current of air through the galleries. At Pechelbronn, according to van der Gracht, the

[1] Acknowledgment is here made to John R. Lawson, Dr. Eliot Blackwelder, and James Dalrymple, with whom I was associated in these studies.

[2] See Camsell, Charles, and Buisson, Arthur, "Recovery of Oil by Shafts and Galleries in France and Germany," *National Petroleum News*, May 21, 1924, pp. 99-103; van der Gracht, W. A. J. M. van Waterschoot, "Will America Come to Mining for Oil?" *Oil and Gas Journal*, Oct. 23, 1924, pp. 25 ff.; de Chambrier, Paul, "Exploitation du pétrole par puits et galeries," Dunod, Paris, 1921. For further references see bibliography at end of paper.

amount of air allowed is 6 cu.m. (about 211 cu.ft.) of air per man per minute. Ventilation must be much more thorough than in a coal mine, because petroleum vapors are much more easily ignited than methane; they form an explosive mixture at a lower concentration, and they are more poisonous. Their toxicity, however, causes pronounced physiological symptoms at a concentration lower than the explosive limit, so that warning is given of dangerous concentrations of gas. Ventilation of an oil mine is, nevertheless, simpler than that of a coal mine in the respect that the workings form a simple pattern through which air may be forced more readily and effectively than through the numerous entries and rooms of a coal mine.

The German methods of oil mining, in so far as I have seen descriptions of them, are essentially the same as those used in Alsace.

Development Work Comparatively Expensive

As we noted above, the oil recovery in Alsace amounts to about 20 bbl. per linear foot of tunnel. Though tunnels of the size required for oil mining can probably be driven in ordinary sedimentary rocks for $10 per foot, the special precautions required for driving tunnels in an oil sand, including the non-use of explosives, protection of timbering, trenching for oil drains, fire doors, ventilation, and numerous other items of expense, would undoubtedly raise the cost to at least twice this figure, which approaches the value of the oil recoverable per foot unless the price is high.

The French plan of drainage by a rectangular panel system of tunneling with panels roughly 165x320 ft. in dimensions (50x100 m.) would call for nearly 12 miles of tunnels to drain 160 acres. This would require a considerable capital investment, and, what is much more serious, a very large amount of human labor under more than ordinarily difficult and dangerous conditions. To develop any considerable oil industry on that basis would involve an almost prohibitive labor problem.

Furthermore, if an attempt were made by mining according to the French plan to recover any of the more volatile oils such as those of Pennsylvania, or even the better grades in the Mid-Continent field, the loss by evaporation into the strong air current necessary to ventilate the mines would be a considerable percentage of the total quantity yielded by the sands. The losses which the U. S. Bureau of Mines has shown, and which oil operators have lately come to realize, when ordinary field storage tanks are exposed to the air, suggest something of the serious loss which would take place from the walls of a tunnel through which some thousands of cubic feet of air per minute were being forced.

Although the oil-mining method which is being successfully used in France and Germany probably requires too great a labor cost and involves too serious a labor problem to be profitably employed in the United States until oil becomes much more valuable than now, it is here suggested that a modified form of the mining method, combined with the American methods of artificial "drive" by water or compressed air, has possibilities for the recovery of oil at costs low enough to be attractive even at present prices.

By indirect mining methods is meant the indirect attack of the oil sand from tunnels driven through the rocks close to it, either above or below, but entirely outside the sand. Such methods, it is believed, would have the advantage of eliminating a large part of the difficulty and danger which necessarily attends an attempt to drive tunnels in the oil sand itself. They would permit the use of explosives for driving the tunnels; they would greatly decrease the fire hazard; they would avoid much of the ventilating difficulty and nearly all of the oil loss from evaporation, and they would permit saving valuable petroleum vapors.

A number of plans for indirect oil mining have been proposed, and practically all of them have been patented or are the subjects of patent applications.

Even as early as 1865, two patents on such methods were granted.[3] The first covered the process of sinking a shaft into the oil sand and from it boring more or less horizontal holes radially out into the sand. The second covered the sinking of a shaft to a point close above the top of the oil sand, driving tunnels in various directions out from it above the sand, and from these tunnels boring holes either vertically or obliquely down into the sand.

French and British patents[4] have been taken out, and it is understood that an application is on file in the United States for an indirect mining method, which we shall have occasion to refer to as the Ehrat method, consisting of driving tunnels either above or below an oil sand and from these tunnels boring holes either up or down into the sand; lining the mouths of the holes, with pipes or nipples, so far as necessary, and connecting these with a system of pipes in the galleries, through which the oil is pumped to the surface. The specifications further provide for the forcing of air, water, or other fluids into certain of the holes, to drive the oil out into adjacent holes.

Ehrat and Ranney Processes Similar

The process disclosed in the Ehrat patents appears to be almost identical with the recently described Ranney process[5] for which U. S. patent applications have been made and in which an interest is reported to have been acquired by the Standard Oil Co. of New Jersey.

Another recent United States patent on an indirect mining method[6] covers a process consisting in sinking a shaft to the neighborhood of an oil sand; driving tunnels close to the oil sand, either above or below it, and preferably inclosing a more or less regular rectangular area; cutting narrow slits, or "channels," such as are used in rock quarrying, into the oil sand from the floor or roof of the adjacent tunnels; providing means of preventing uncontrolled escape of gas into the tunnels while the channels are being cut and subsequently; and, finally, applying artificial pressure to the sand in the area inclosed by the tunnels and channels through the agency of compressed air, water, steam or other fluids applied through wells drilled from the surface, much as is done in the usual methods of water flooding and compressed-air drive.

A late United States patent,[7] which, in some respects, is similar to the Ehrat patent, covers the sinking of a shaft to a point below the oil sand; the excavation of a working chamber below the sand; the boring of holes from the working chamber radially upward in various directions into the oil sand; and the application of heat to the sand through pipes in some of these holes.

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[3] Casamajor, Paul: U. S. Patent No. 50,902 and No. 50,903, 1865.
[4] Ehrat, Adolph: French Patent No. 528,061, August, 1921; British Patent No. 175,116, February, 1922.
[5] *National Petroleum News*, Nov. 5, 1924, pp. 63-67.
[6] Rich, John L.: U. S. Patent No. 1,507,717, Sept., 1924.
[7] Wright, Robert L.: U. S. Patent No. 1,520,737, Dec., 1924.

A semi-indirect mining method,[8] for which United States patents were recently issued, covers the driving of tunnels directly in the oil sand with the aid of a movable shield and air dam which can be shifted forward as the tunnel is advanced. This shield is similar to the shields used in tunneling through unconsolidated formations and is designed to prevent gases from the working face contaminating the air of the main tunnel and for keeping the bleeding surfaces of the sand free from the evaporative action of the ventilating current. From the space behind the air dam it is proposed to bore advance holes into the oil sand which serve as drains and lead the oil into sumps in the space ahead of the air dam, from which the oil is pumped to the surface. When one set of advance holes has ceased to produce, the air dam is to be opened, the exhausted sand removed, and the air dam pushed forward to a new position from which the process is repeated. It is also proposed to apply compressed gases through certain of the advance bore holes, so as to hasten the movement of the oil into the others.

With respect to two of the methods of indirect mining described above—namely, (*a*) the boring of holes into the sand from adjacent tunnels and (*b*) the cutting of channels through the sand from the roof or floor of an adjacent tunnel—it appears to me that either one would be effective, though under some conditions one would be more readily applicable than the other, and that, where other things are equal, the factor governing the choice of method would be whether the greater and more speedy oil recovery from the larger seepage area of a channel would more than offset the greater ease with which the holes could be bored.

It was the plan of the group of which I was a member to drive tunnels around the area from which it was desired to extract the oil and to use water flood or compressed air applied from the surface to the central part of the inclosed area to force the oil into the tunnels. Driving the tunnels in the oil sand itself was considered as a possibility, but it was also the plan to experiment with the channeling method above referred to, and also with what is essentially the Ehrat method of boring into the sand at short intervals from a tunnel above or below it. It appeared that the factor which would determine the relative value of the channeling and the Ehrat methods would be the relative effectiveness of the two in promoting free and rapid drainage of the deposit. By the use of the Ehrat method with 2-in. holes drilled in the roof of the tunnel at 5-ft. intervals along it, the seepage area would be only one-twentieth that of a channel. Whether the rate of bleeding would be proportional to the seepage area, and, if not, what the proportionate rate would be, is a question which only experience can settle. Even a moderate increase in seepage rate would be likely to counterbalance the somewhat greater cost and difficulty of the channeling method.

To make clear the plan of operation of the combined mining and restored pressure method, and to obtain a basis for rough cost comparisons, we may consider their application to a 640-acre tract which we may assume is underlain by a relatively uniform, continuous oil sand. Fig. 1 shows the plan of operation.

In the estimates, one operating shaft and one air shaft are allowed. From the foot of the shaft it is assumed that tunnels are driven entirely around the tract and across it at one-quarter mile intervals, dividing it into four narrow 160-acre tracts completely surrounded by tunnels (Fig. 1). Whether these tunnels are driven in the oil sand or are driven outside of it, and the sand cut by channels or perforated by bore holes, is immaterial for the purposes of this estimate. For forcing the oil out into the tunnels it is assumed that a row of twenty-seven wells, spaced as in the Bradford flooding estimates, is drilled lengthwise along the center of each 160-acre strip. The depth is taken as 1,500 ft., so as to give rough cost comparisons with the Bradford flooding method.

The following items of mining cost are necessarily rough approximations, but they are believed to be conservative. Each item of mining cost is estimated considerably higher than it is believed would be necessary in large-scale operations after mining methods had become standardized. Estimates for tunnels are made a little more than double the ordinary cost of tunneling, to allow ample margin for extra costs of channeling, drilling bore holes, or other operations necessary in an oil mine.

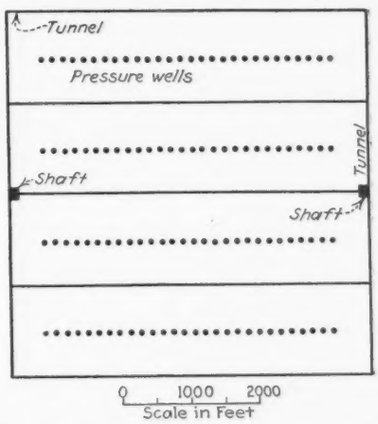

Fig. 1—Ground plan for operation of combined mining and restored pressure method. A row of twenty-seven wells is driven along lengthwise the center of each 160-acre strip

Estimated Mining Cost for a 640-Acre Tract

1 working shaft 1,500 ft. deep @ $100 per foot	$150,000
1 air shaft 1,500 ft. deep @ $80 per foot	120,000
108 pressure wells @ $2,150 (same spacing and cost as in Bradford flooding estimates)	232,200
36,820 ft. of tunnels @ $30 per foot	1,104,600
Machinery and equipment	75,000
Overhead, interest, and incidental	250,000
Total development cost	$1,931,800
Total development cost per acre	3,019
Mining cost per barrel, 3,000 bbl. per acre	$1.006
Mining cost per barrel, 6,000 bbl. per acre	.503
Mining cost per barrel, 7,500 bbl. per acre	.4025

To each of the above per-barrel figures should be added a lifting cost, estimated not to exceed 10c. per barrel, which would raise the above figures to roughly $1.11, $0.60, and $0.50 per barrel for recoveries of respectively 3,000, 6,000 and 7,500 bbl. per acre.

The above cost estimates may be varied considerably without greatly increasing the indicated cost per barrel. For instance, if it were found desirable to drive tunnels across the tract at one-half the distance apart above estimated, thus doubling the number of water holes and requiring a total of four miles of additional tunneling, other figures being the same, the estimated mining cost per acre would rise to $4,371, and the per-barrel cost, including the 10c. per barrel lifting charge, to $1.557, $0.828, and $0.683 for per-acre recoveries of 3,000, 6,000, and 7,500 bbl. respectively.

It is doubtful if such close spacing of tunnels and pressure holes would be either necessary or desirable, but the figures are given to indicate, roughly, how greatly the cost of operation as outlined in the first estimate may be increased without raising the estimated

[8]Schneiders, G.: U. S. Patent No. 1,418,097, May, 1922.

cost per barrel to the level required for the Bradford flooding method.

As an approximate minimum estimate which, it is believed, is not too low for standardized large-scale operations, and which in that respect is believed to be more nearly comparable than the first estimate with the Bradford flooding estimate given herewith, we may take the cost of shafts as $60 and $40 per foot for the working shaft and air shaft respectively, and the cost of tunnels, with their necessary channels or bore holes, as $20 per foot, other costs remaining as in the first estimate. On that basis the per-acre mining cost is $2,255 and the per-barrel cost, including lifting, is $0.852, $0.476, and $0.40 for recoveries of 3,000, 6,000, and 7,500 bbl. per acre.

Estimated Costs Moderate

Even on small-scale operations the estimated costs are not excessive. For instance, on a single 160-acre tract requiring two shafts, with shaft, tunnel, and pressure well costs as in the first estimate and surface equipment and overhead in proportion, the mining cost amounts to only $5,262 per acre and the per-barrel cost, including lifting, to $1.854, $0.977, and $0.802 for per-acre recoveries of 3,000, 6,000 and 7,500 bbl. respectively.

The actual capital outlay for such a project is much less than the total costs, because the tunnels may be counted on to pay their way from the seepage oil which drains into them. In Alsace, from an 8- to 10-ft. sand, this averaged 20 bbl. per running foot, which, at $1.50 per barrel, would balance the estimated cost of the tunnels. The actual capital outlay would therefore, in all probability, be confined to the cost of shafts and equipment for power and hoisting. Seepage into the tunnels should also finance the drilling of the pressure wells if oil were bringing considerably more than $1.50.

For the testing of the plan a shallow field might be chosen where shaft costs would be small. In that way the cost of proving the plan would not exceed that of many a single deep test well.

For the following estimate of costs of a flooding operation at Bradford, Pa., I am indebted to Lincoln Johnson, of New York City, who has had occasion to go into the matter in detail.

Mr. Johnson's estimates were based on the intensive operation of five square tracts of 200 acres each on which four flood faces were to be started simultaneously by drilling two parallel rows of water wells across each tract. Oil wells were to be drilled in rows 175 ft. apart, with the wells in each row about 164 ft. apart. It was assumed that the average rate of forward movement of the flood faces would be 58 ft. per year; that the operation would require sixteen years; and that the average yield would be 3,000 bbl. per acre flooded. Cost of water wells was taken at $2,150 and of oil wells $2,500, after including proportionate cost of storage tanks and crediting for material recovered. The average lifting cost was estimated at $0.59 per barrel. A summary of the cost estimate for 1,000 acres follows:

Barrels of oil recovered	3,000,000
Disbursements	
Drilling water wells	$408,500
Drilling oil wells	3,700,000
Camps, construction, and powers	170,000
Lifting oil	1,770,000
Administrative and office	960,000
Miscellaneous expense	50,000
Total	$7,058,500
Average disbursements per acre	$7,058.50
Cost per barrel, recovery 3,000 bbl. per acre	$2.352

Using the same figures and allowing only for the difference in lifting cost, the per-barrel cost for a recovery of 6,000 bbl. per acre would be $1.471, and for a recovery of 7,500 bbl. per acre, $1.295.

These figures are to be compared with estimated costs of $1.11, $0.60, and $0.50 per barrel for recoveries of respectively 3,000, 6,000, and 7,500 bbl. per acre by the mining method, and, on large-scale operations, with possible mining costs of $0.852, $0.476, and $0.40 respectively.

In comparing these cost estimates for the mining and flooding methods, it must be borne in mind that for estimates of the cost of flooding a basis of actual experience exists, while for oil mining by the method suggested detailed cost estimates are impossible. In connection with our proposed operations attempts were made to itemize mining costs in all possible detail, but it is useless to repeat such estimates. Suffice it to say that they fell well within the figures here used.

Under any of the assumptions made in estimating mining costs, the figures are considerably below flooding estimates for corresponding recoveries. It thus appears that in the matter of total cost the combined mining and restored pressure method promises to be more attractive than flooding, but other advantages inherent in the mining method, particularly in the low lifting cost which it makes possible, offer possibilities for increased recovery which further lower the indicated cost per barrel.

Advantages of the Mining Method

1. Low lifting cost is one of the advantages inherent in the mining method, which brings in its train several other economies not evident at first thought. Under the mining method the entire product of a mine can be brought to the surface by one large mine pump. The cost of lifting water 1,500 ft. by such pumps, based on figures given in Peele's *Mining Engineer's Handbook*, would vary from 0.15 of a cent to 1.23c. per barrel. Viscosity of oil and smaller volumes of fluid to be lifted from an oil mine would raise this cost, but the figure of 10c. per barrel used in the above estimates is believed to be conservative. With an oil recovery of 7,500 bbl. per acre, the difference in lifting cost alone between 59c. and 10c. per barrel would go far toward paying all mining costs.

2. Greater recovery. Decreased lifting cost means that if water flood were used, the circulation could be kept up through the sands long after the proportion of water coming through would force the abandonment of ordinary wells. As a result of this, a considerable increase in total recovery should be expected.

3. The use of heated water might become practicable, for circulation through the sand could be kept up until the heat had affected the entire sand body, whereas the front of an advancing flood would always be cool and an ordinary well would be drowned out before any benefit could be derived from the heat. The successful application of heated water has possibilities for greatly increasing oil recovery.

4. Speedier recovery. Undoubtedly the rate of travel of a water flood would be greater toward a gallery or channel completely transecting the sand than toward a series of wells. Quicker recovery is a decided advantage.

5. Finally, under the mining method, a flood could be controlled and confined to the one property in which it was started, and no oil would be lost to neighbors.

The cumulative economies which the considerations set forth show to be inherent in the combination of the mining method, with the artificial restoration of pressure, open at least the possibility that this may prove, in cost per barrel, to be by far the cheapest method of producing oil from old fields and possibly also from new ones where pressure is low and depth not great.

The amount of oil which it is possible to recover by such methods from an "exhausted" field obviously depends, in the first place, on the amount actually left in the sands, and, in the second place, on the proportion of this which can be recovered by the mining methods.

Current estimates place the amount of oil left in the sand after pumping becomes unprofitable at 50 per cent to 90 per cent of its original oil content. Caution must be exercised in accepting these estimates. As will be shown, they are likely to be misleading.

If, however, we find that in an "exhausted" field there remains as much as 10 ft. of fully saturated sand of 20 per cent porosity or its equivalent, we have a reserve of 15,500 bbl. per acre. A recovery of at least 50 per cent of this by mining and flooding methods seems reasonable. At the mining costs estimated above, a recovery of 50 per cent from even 5 ft. of fully saturated sand or its equivalent, with oil at $2 per barrel, shows a possible profit of $3,400 per acre over costs and, of course, much more than this over actual investment.

Within the last two years a number of east Kansas shallow oil properties were tested with a core drill for the purpose of determining their suitability for oil mining by the method outlined in preceding paragraphs. It was known that these properties had never been profitable, but the logs of the wells showed 15 to 25 ft. of oil sand which the operators considered to be "pay"; the gas pressure was known to be low; and it was thought the poor showing of the wells might be due to shallow depth and lack of gas pressure.

What Two Cores Showed

On one property two cores were taken between old wells on a completely drilled lease. Logs of the adjacent wells showed 16 to 23 ft. of oil sand. About 20 ft. of sand was actually found, but of that, only 5 ft. had ever held any oil, and only 6 in. of rock in one well and 1 ft. in another carried any "live" oil. This was not in the 5 ft. of fairly clean, dry oil sand, but was in an immediately overlying bed of minutely cross-bedded sand and shale where the oil appeared to be inextricably trapped. Since compilation of oil runs showed that the total amount of oil recovered from the property by wells amounted only to the capacity of less than one-half inch of sand of 15 per cent porosity, the poor showing of the cores clearly was not due to depletion by the wells.

On another property two tests were drilled near, but not among, the old wells. About 14 ft. of oil sand was found, but this consisted of minutely laminated oil sand and shale. In the 14 ft. there was scarcely an inch which did not contain from five to twenty laminæ of oil sand, yet there was nowhere in the core a bed of oil sand as much as half an inch thick! This laminated sand and shale, in churn-drill cuttings, showed mainly sand with relatively small amounts of shale, which the drillers interpreted as "cavings." From churn-drill cuttings the true nature of the "sand" would never have been suspected.

A third property on which four core tests were made showed 30 to 40 ft. of so-called oil sand. The core of the test showing the most oil revealed that there were two principal oil zones. The upper one, 12 ft. thick, consisted of minutely cross-bedded and intricately laminated oil sand and shale, Fig. 2. The sand laminæ were mostly thin and made up not more than one-third of the total thickness of the zone. These sand laminæ contained "live" oil which bubbled freely out of the cores, but it is difficult to imagine how such an intricately laminated and cross-bedded formation could yield any considerable amount of oil to a well or even to a mine. To test the yield of this sand, a bailing test was made of an adjacent hole where this zone was 10 ft. thick. The yield was three quarts of oil in five and one-half days. It is evident that such oil "sands" are yielding little or nothing to the wells where they occur, yet they are usually counted in logging the total thickness of oil sand.

The lower oil zone on this property, about 11 ft. thick, consisted of relatively uniform, porous sand, but it was very poorly saturated. Pieces of fresh core, when cracked open, showed the spaces between sand grains almost free of liquids. Only the upper foot or so of this zone showed any considerable degree of saturation. A bleeding test yielded 3 gal. of oil in fifteen hours.

Other tests on this property showed similar conditions. Comparison of the positions of the "pay" in the different holes indicated that the "pay" lenses are irregularly distributed in the sand body, so that any recovery methods which might be applied to that locality would be dealing, not with a single uniform sand bed, but with a series of lenses at slightly varying levels whose connection with each other would be problematical.

Another property, which had never been developed, showed 23 ft. of relatively clean oil sand, all stained brown with oil, but of this the upper 18 ft. was practically dry. Fresh fragments of the core showed only slight oozing of oil, and the dryness of the sand pores could be plainly seen under the hand lens. The bottom 4 ft. of the sand, however, was richly saturated with oil, as could be ascertained readily from the bleeding of the core after being washed repeatedly and from a microscopic examination of the freshly broken core. The porosity of this sand was 24 per cent as determined by the U. S. Geological Survey. This would give an oil content of 1,860 bbl. per acre-foot, or 7,440 bbl. per acre for the 4 ft., yet in a bleeding test this well yielded only 3 gal. of oil in fifteen hours. This was the clearest proof which we obtained that with low gas pressure the yield of oil into a well is very small, even when the

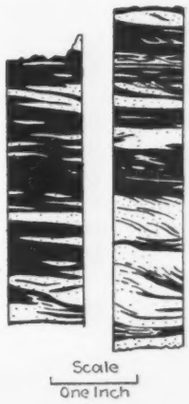

Fig. 2—Tracing of sections of a core of typical cross-bedded and laminated "oil sand" such as is very common in the east Kansas shallow fields. The dark areas are shale, the light stippled areas sand. Such sand shows oil freely and appears to be well saturated, but it is of doubtful economic value, on account of the shale laminations hindering movement toward a well

well cuts porous, fully saturated sand containing a large per-acre reserve of oil.

More recently others have made a number of diamond-drill tests of producing properties in deeper territory than that in which our tests were made. The results of these tests were essentially the same as ours, and, taken in connection with them, show that a continuous, clean, saturated oil sand of any considerable extent is rare indeed; that a low degree of saturation is widely prevalent; and that minute interlamination and cross-bedding of oil sand and shale is exceedingly common. What the conditions may be in the shallow fields of other parts of the United States only similar core tests can show.

The disappointing results of these core tests emphasize the need of the greatest caution in accepting the current widely published estimates of the large amount of oil left in the sands after "exhaustion" by ordinary pumping methods. Some of these estimates have been made by dividing the estimated pore capacity of a sand body of the thickness shown by driller's logs by the amount of oil actually recovered from the developed properties or expected from them on the basis of their decline curves. That such estimates may be erroneous is readily apparent on consideration of the conditions revealed in the core tests.

Undoubtedly in some of the deeper parts of the east Kansas shallow fields the sands are locally better saturated than were those tested, and considerable lenses of clean, saturated sand undoubtedly exist, but they appear to be the exception rather than the rule.

In general, these core tests show that we do not have in the old, shallow fields, in eastern Kansas, at least, a recoverable oil reserve of anything like the magnitude which might be expected. In considering our oil reserves, unless conditions revealed by these tests are properly discounted, we are likely to count on a much larger reserve than actually exists.

Undoubtedly large amounts of oil are held in the intricately laminated and cross-bedded sand and shale shown by the cores, but it is difficult to imagine how this can be recovered, either by compressed air, water flooding, or mine drainage.

As to oil mining, these tests show that driller's logs are entirely undependable as guides to the value of a property and that careful core testing is an essential preliminary to any attempts at mining, as, in fact, it should be to attempts at increased recovery by any method.

It is further evident that, in any proposed mining operation, the nature and degree of saturation of the sand body is a vital consideration and that estimates of mining costs and recoveries such as those presented in this paper could easily be completely upset by unfavorable sand conditions. Nevertheless, there is no doubt that, by careful selection and core testing, properties can be found which contain enough oil in available form to justify the application of mining methods for its recovery.

In conclusion, oil mining is commonly referred to as a last resort, to be undertaken only at some time in the distant future when oil becomes scarce and the price high. It is here submitted that by such modifications of the European mining methods as are suggested in this paper, oil mining, in combination with the application of artificial water or air drive, offers attractive possibilities for the recovery of oil at present prices and in favorable competition with methods now in use. But it is evident that the nature of oil sands is such that very careful selection of properties must be made.

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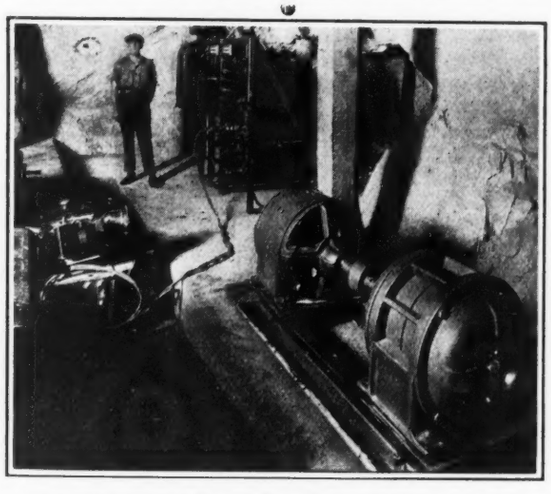
Deepest Mine Locomotive

What is probably the deepest mine locomotive installation in the world is a unit in service on the thirty-first level of the Village Deep mine, in South Africa, 6,300 ft. below the surface. The locomotive is a



Locomotive switchboard and generator on thirty-first level, Village Deep mine, The Rand, South Africa

6-ton, 30-in. gage, 2,400-lb. G.E. unit. The photograph shows the battery-charging equipment in operation. Two batteries are used, this arrangement making it possible for the locomotive to be in almost constant service. One battery is in use while the other is being charged.

Floating and Leaching Copper-Molybdenum Ores*

Laboratory Experiments Indicate Copper Can Be Recovered at a Profit From an Impure Molybdenite Concentrate

By H. A. Doerner
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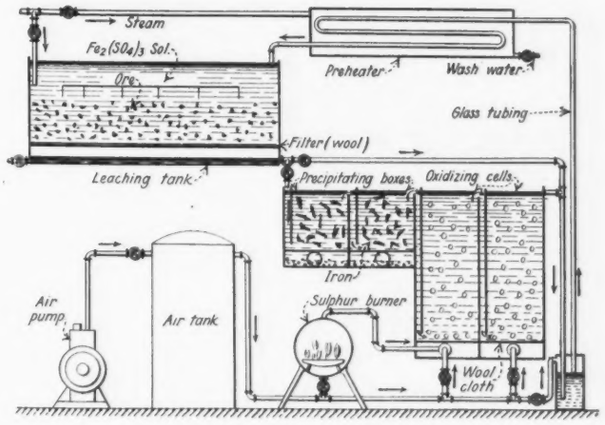
MOLYBDENITE DEPOSITS frequently contain considerable copper sulphide, and in few molybdenum ores is the copper content negligible. In ordinary concentration much of the copper remains with the molybdenum. Since a molybdenum concentrate containing over 1 per cent copper is practically unsalable, and because even smaller quantities are usually penalized, the problem of separating the two minerals is of commercial importance. Flotation appears to be the best method for concentrating a molybdenite ore, and if relatively little copper is present it is usually possible to float a molybdenum concentrate containing less than 1 per cent of that impurity. No instance is known of an ore being successfully treated for both copper and molybdenum; no mechanical methods give sufficient separation, and chemical methods are too expensive.

Molybdenite floats readily with almost any oil and to some extent without any oil at all, especially in alkaline solutions. It is resistant to surface alteration, and none of the usual flotation reagents have much inhibiting effect in its flotative properties.

The ore selected for testing at the University laboratory was a typical molybdenite ore containing 3 per cent molybdenum sulphide, together with 3.2 per cent copper as bornite, chalcopyrite, and their alteration products. The gangue was nearly pure quartz. Many tests were made with different oils and the following reagents: sulphuric acid, sodium hydroxide, sodium hydroxide and soap, sodium carbonate, sodium bicarbonate, sodium suphide, sodium cyanide, lime, ferric chloride, hydrogen peroxide, sulphur dioxide, air, kerosene, and several combinations.

The flotation of copper is inhibited by hydrogen peroxide, sulphur dioxide, and ferric chloride with aëration, especially at elevated temperatures, so that no satisfactory recovery of the copper was obtained after using any of these reagents. But by using kerosene without any other oil or reagent, the molybdenum floats as a fairly clean concentrate, although there is no froth, and the copper is readily floated later by using any suitable oils. The molybdenum concentrate may then be cleaned by a second treatment in which the flotation of the copper is inhibited by sulphur dioxide, yielding high-grade concentrate and middling products. The following data are typical of several tests. The rougher tests were made in a Ruth laboratory machine on 1-kilogram samples ground to 60 mesh with 48 per cent through 200 mesh. The molybdenum concentrates from two such tests were combined for a cleaning test in a smaller Janney machine.

It does not appear probable that a more complete separation of molybdenite and copper minerals can be obtained by flotation alone without sacrificing the recovery of one or the other. The results, although remarkably good for selective flotation, do not indicate that a good recovery can be made in a molybdenite concentrate that will meet market requirements, and there is no assurance that even equally good results can be obtained with other ores and conditions. For general application, a method assuring more positive and complete separation is essential, and it does not seem likely that any mechanical treatment will accomplish this. Through selective flotation, however, the molybdenite is sufficiently concentrated so that a chemical treatment to eliminate the remaining copper becomes a much simpler problem.



Flow sheet of proposed leaching and precipitating process

Roughing Test

Product	Per Cent of Feed	Per Cent MoS_2	Per Cent of Total MoS_2	Per Cent Cu	Per Cent of Total Cu	Reagents, Pounds per Ton
Feed	....	3.0	....	3.2	....	.....
(1) MoS_2 conc.	3.2	83.1	87.2	2.85	2.8	2.0 Kerosene
(2) Cu conc.	8.0	3.54	9.5	35.0	86.1	0.5 G.N.S. No. 17 and No. 22 0.1 G.N.S. No. 4
(3) Tailing	88.8	0.21	3.3	0.44	12.1	.....

Cleaning Test

(4) MoS_2 conc. feed	2.25	94.5	71.1	1.11	0.8	0.3 SO_2 1.0 Kerosene
(5) MoS_2 conc. feed	0.51	87.3	14.6	2.88	0.5	0.05 G.N.S. No. 4
(6) Tailing	0.44	10.2	1.5	11.77	1.5	.....
(4) + (5)	2.76	92.4	85.7	1.45	1.3	.....

A chemical separation may be made in many ways, most methods that have been proposed involving a preliminary heat treatment. Roasting and extraction of the molybdic acid with caustic; distillation of molybdenum oxide, chloride, oxychloride or hydrochloride; and fusions with alkali and alkaline salts are typical. But for removing copper from a high-grade concentrate, treatment with a reagent capable of dissolving the copper minerals without attacking the molybdenite is much preferable.

A solution of sodium cyanide, or ferric chloride, or ferric sulphate has no action on molybdenite and dissolves copper sulphides slowly at room temperature, but rapidly and completely when hot. The cyanide reagent is expensive and its consumption in unrecoverable form

*A communication to *Mining Journal-Press* from the Rare and Precious Metals Experiment Station of the U. S. Bureau of Mines, in co-operation with the University of Nevada.

is high. Of the two ferric salts, the sulphate is more easily and cheaply regenerated by oxidation with sulphur dioxide and air by the Leaver process, developed by the U. S. Bureau of Mines.[1]

Ferric chloride reacts with copper sulphide as follows:

(1) $Cu_2S + 2FeCl_3 = 2CuCl + 2FeCl_2 + S$

(2) $CuS + 2FeCl_3 = CuCl_2 + 2FeCl_2 + S$

After precipitation of the copper the solution is treated with chlorine to regenerate the ferric chloride.

In a cold solution, ferric sulphate reacts differently:

(1) $Cu_2S + Fe_2(SO_4)_3 = CuSO_4 + 2FeSO_4 + CuS$

(2) $2CuS + 2Fe_2(SO_4)_3 + 3O_2 + 2H_2O = 2CuSO_4 + 4FeSO_4 + 2H_2SO_4$

The second reaction takes place slowly and requires a large supply of oxygen, but at high temperature the reaction is rapid and complete without any exposure to air or other source of free oxygen. As free sulphur is liberated, the following reaction is indicated, although quantitative datum to establish it is lacking:

(3) $CuS + Fe_2(SO_4)_3 = CuSO_4 + 2FeSO_4 + S$

The ferric sulphate is regenerated by treating the solution with sulphur dioxide and air as follows:

$$2FeSO_4 + SO_2 + O_2 = Fe_2(SO_4)_3$$

The accompanying diagram represents equipment and operation of a complete process for leaching with ferric sulphate, precipitation of copper from the solution, and regeneration of the ferric sulphate.

The daily production of molybdenite concentrate is run into the leaching tank or tanks and allowed to drain. Hot ferric sulphate solution (about 3 per cent iron and 1 per cent free acid) is then added continuously, percolating slowly through the bed of concentrate. The copper-bearing solution then passes through the precipitating boxes, where the copper is precipitated by scrap or sponge iron, and next through the oxidizing cells, where the ferrous sulphate is converted to ferric sulphate by the reaction with sulphur dioxide gas and air. The regenerated solution is raised by an air lift to a preheater, from which it again enters the leaching tank, thus making the operation continuous. When the copper has been sufficiently extracted, the flow of solution is diverted to another leaching tank filled with fresh concentrate, and wash water is added to displace the solution remaining in the leached ore.

The conditions that must be controlled are as follows:

1. *Dissolution*—The solution entering the precipitation boxes should contain but little free acid or ferric iron. As the concentrate becomes lean in copper, the solution will contain excessive ferric iron and should be returned to the leaching tank without passing through the precipitation and oxidation cells.

2. *Precipitation*—The copper precipitates quickly from the hot solution. To prevent excessive consumption of iron, the rate of flow and the surface of iron exposed should be regulated so that the copper is not completely precipitated. Inasmuch as the iron content of the solution is continually augmented by this replacement, a portion of the solution from the precipitation boxes is diverted to an extra box, where the remaining copper is precipitated and the barren solution is discarded.

3. *Oxidation*—The reaction in the oxidizing cells is regulated by the air valves, which control the supply of air and sulphur dioxide. For good results, the ratio of sulphur dioxide to air should be less than one to ten. The actual chemical reactions are not definitely known but may be assumed as follows:

(1) $2FeSO_4 + SO_2 + O_2 = Fe_2(SO_4)_3$

(2) $Fe_2(SO_4)_3 + SO_2 + 2H_2O = 2FeSO_4 + 2H_2SO_4$

Combining (1) and (2)

(3) $2SO_2 + O_2 + 2H_2O = 2H_2SO_4$

Reaction (2) is negligible until the iron is almost completely oxidized by reaction (1) and it then increases rapidly until the rates of the two reactions are equal, the result being reaction (3). A certain minimum of reaction (2) is unavoidable and desirable because the free acid prevents precipitation of basic ferric salts and assists in dissolving the copper. A large excess of acid is both wasteful and troublesome, so the total quantity of sulphur dioxide entering the cells must be governed by the acidity of the solution, which should not be over 0.2 per cent when it enters the precipitation boxes.

The consumption of reagents is theoretically about one pound each of iron and sulphur per pound of copper leached and should not exceed that amount by more than 50 per cent.

Although the particular combination of elements proposed for this leaching process has not been developed beyond the laboratory state, each detail, except the rapid extraction of the copper by the hot ferric sulphate solution, has been successfully used in commercial operation. The dissolution of copper was demonstrated by laboratory experiments on samples of flotation concentrates. Boiling with an excess of 5 per cent ferric sulphate solution for three hours, or heating for six hours without boiling or agitation, gave complete dissolution of copper. Agitation for twenty-four hours at 40 deg. C. gave 68 per cent extraction. With an excess of copper, complete reduction of the ferric sulphate was accomplished by heating over night. The molybdenite was not measurably attacked in any test. The molybdenite concentrates have physical characteristics which make percolation easy and entirely satisfactory.

There is little doubt that even a high percentage of copper can be extracted from a molybdenite concentrate at a profit from the copper recovered. This leads to the question of the amount of separation which will be most profitable in cleaning the first flotation concentrate. Without chemical extraction of the copper, concentrate No. 4 in the table would require even more closely controlled separation, with the resulting decreased recovery. But in connection with the leaching process, concentrates No. 4 and No. 5 may be combined to give a total recovery of over 85 per cent in a high-grade product. Incidentally, many other objectionable impurities, such as arsenic, antimony and phosphorus, will also be eliminated.

The difficulty and expense of freeing molybdenite from copper minerals have always been considered sufficient to prohibit the recovery of molybdenite from a copper-bearing ore. By the foregoing process the profit from treating a molybdenite ore will be increased instead of diminished by the presence of copper.

By a combination of selective flotation and leaching with ferric sulphate solution on a typical molybdenite ore containing 3.0 per cent molybdenum sulphide and 3.2 per cent copper, over 85 per cent of the molybdenite was recovered as a high-grade product free from copper, and over 85 per cent of the copper was obtained in a concentrate of 35 per cent copper. A small fraction of the copper was recovered as cement copper.

[1]Charles E. van Barneveld and Edmund S. Leaver, "Leaching Non-sulphide Copper Ores with Sulphide Dioxide." Technical Paper 312. Edmund S. Leaver and R. V. Thurston, "Ferric Sulphate and Sulphuric Acid From Sulphur Dioxide and Air." *Reports of Investigations* No. 2,556, Bureau of Mines.

Mining Hematite Paint at Clinton, N. Y.

Novel Combination of Longwall Coal and Joplin Zinc-Lead Mining Methods

By William Spence Black
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THE FRANKLIN HEMATITE mine is situated near the village of Clinton, N. Y., where iron ores of the Clinton formation were first recognized and from which locality they derive their name. Hematite ore is mined for the manufacturer of paint by a novel combination of mining methods that includes the advancing longwall system of the coal fields and the tramming and hoisting methods of the Joplin zinc district. The mine and plant were developed and equipped under the direction of Hutchinson & Livermore, consulting engineers, of Boston. The Clinton district was formerly an important producer of iron ore, and is credited with a production of 5,000,000 tons.

The mine was developed and equipped during the summer of 1923 and has been producing steadily since that time. The ore is an oölitic hematite and is used as a pigment in paints and mortar colors manufactured by the Clinton Metallic Paint Co. The ore is soft and red, and stains everything with which it comes in contact. Its value as a pigment was recognized by the early settlers, and they prepared small batches by grinding with cannon balls in iron kettles. The Indians are believed to have used the ore for war paint, and the appearance of the miners and millmen confirms the effectiveness of its use for such a purpose.

The hematite ores in the neighborhood of Clinton were originally mined for their iron content, and a mining lease is said to be on record that was granted in 1797. Forges were first used to reduce the ore; later came the charcoal furnaces, and in 1852 the Franklin Iron Works erected a furnace using anthracite. This plant was situated at Franklin Springs, one mile south of Clinton. In later years other furnaces were erected, and from 1870 to 1907 the mines were operated on a relatively extensive scale. Since that period the production has been more limited, and most of the ore has been used in the manufacture of paint.

The ore bed is from 18 to 30 in. thick, with a slight but appreciable dip to the south and west. It occurs in a shale and limestone formation and varies in width and in quality, but for the most part it constitutes a remarkably persistent and dependable orebody, which underlies all the country east, south, and west of Clinton. The first mining was all done along the outcrops, and the overlying shales were removed by stripping, but the economic limit for stripping appears to have been reached when the overburden exceeded 15 to 20 ft. in thickness, and underground mining was then started.

The advancing longwall method of mining was adopted, and in the larger mines the working faces were advanced until distances of as much as 1,500 to 2,000 ft. from the outcrops were attained. In actual depth these workings rarely exceeded 100 ft., as the overlying country had only slight relief, and the progress of the mining was generally up the dip of the ore bed. Openings to the surface from the mine workings were occasionally made to improve the ventilation, but no other advantage was taken of the shallow depth, and the raises, or shafts, were not equipped for hoisting. The plan of development for the Franklin mine involved reopening one of these old mines. Some of the tunnels were still open, and the old working face could be reached at several points. Samples of the ore were taken and found to be of good quality, but there were many obvious disadvantages to attempting to work the mine through the old tunnels. To do so meant the rehabilitation of the old haulageways, the laying of pipe and track, and the maintenance of haulageways through a zone of subsidence. A vertical shaft was therefore decided on, and, after a survey had been made, a shaft was sunk to the ore bed just ahead of the old workings. A crosscut was then driven to the old face, thus securing ventilation and drainage, and mining was started.

The shaft has two compartments and is 4 by 8 ft. inside the timbers. The hoisting compartment is 4 by 4 ft. and the manway compartment 3.5 by 4 ft. It is timbered with Pennsylvania hemlock, using 8 by 8-in. plates and corner posts, and 6 by 8-in. dividers and divider posts. It is lined throughout with 2-in. lagging. The shaft sets are 5 ft. on centers and are hung with 1-in. hanging bolts. On each side of the hoisting compartment are placed two 1 by 10-in. skid boards to prevent the hoisting bucket from catching on the timbers.

The advancing longwall method of mining is used; the ore bed is carried in the bottom of the face. The ore is first broken and removed, then 1½ to 2 ft. of the overlying shale is shot down. This material is used to build a dry wall 6 or 7 ft. back from the new face. Another cut in the ore is then started. The drilling is done with Jackhamers mounted on tripods. The spacing and pointing of the drill holes is illustrated in Fig. 1.

The drilling round is made up of three types of holes: cut holes, side holes, and slate holes. The cut holes are drilled about every 2 ft. along the face. The exact spacing depends on the character of the ore and the

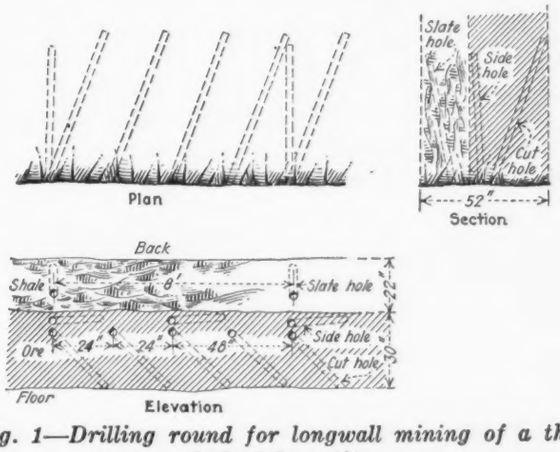


Fig. 1—Drilling round for longwall mining of a thin bed of hematite

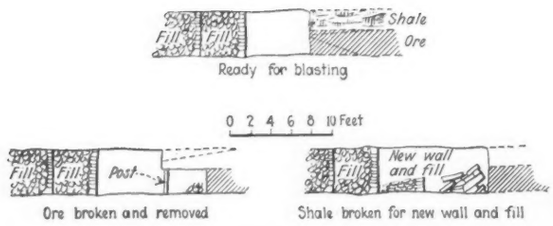


Fig. 2—Showing graphically the cycle of operations in the longwall face

judgment of the driller and blaster. When the ore is hard, the interval is closer than 2 ft., and when soft the interval may be as much as 3 ft. The cut hole is drilled so as to stop just at the bottom of the ore bed, and the side hole must also be bottomed in ore; otherwise the overlying shale is weakened by blasting and may break with the ore or fall on it later. The slate roof is bottomed several inches below the future roof, for unless this is done the shattered shale around the bottom of the hole, after blasting, causes a "blister" in the roof, which starts cracking and slabbing.

The roof is usually very smooth and uniform, and care must be taken to maintain this condition and also to keep the height uniform. The use of light drills and the tripod mounting are explained in part by the fact that an average of less than two holes is drilled from each set-up. The combination is very efficient under the existing conditions, and as many as thirty 6-ft. holes can be drilled in an eight-hour shift with one machine. Columns were originally tried for mounting the drills, but are now used only on development work. The drills are the Ingersoll-Rand DCRW-23 Jackhamers, and they are mounted on 145-lb. tripods. No weights are used on the tripod. The drill steel is 1-in. hollow hexagonal. Water is generally used in drilling, but dry holes will drill faster and are sometimes preferable.

The blasting of the ore is kept well behind the drilling, a section of drilled-up face always intervening between these two operations, so that the drill and tripod will not be disturbed during the blasts. Black powder, of "F" granulation, is used except where wet holes or other conditions make necessary the use of a low-strength gelatine dynamite. The ore is soft, and shatters and pulverizes when broken with dynamite, and preference is therefore given to black powder, so that lump ore with a minimum amount of fines may be secured. Only a few holes are blasted at one time, and this gives the blaster an opportunity to judge carefully the breaking of the ore. A section of the face is opened up by blasting, and the overhanging shale is left in place and supported on short props where necessary. The holes in the ore are drilled on a slight angle

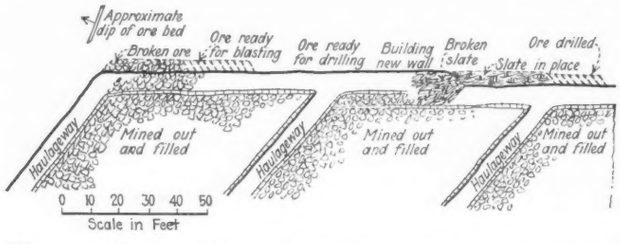


Fig. 3—Sections illustrating the cycle of operation in breaking the ore and then the shale

from perpendicular to the face, and this inclination tends to throw the broken ore outward and reduces the quantity of ore that is scattered back along the face under the overhanging shale.

The broken ore is shoveled into buckets mounted on trucks, as shown in the accompanying illustration. The buckets are 28 in. in diameter and 30 in. deep and hold about 1,000 lb. of ore. Both the buckets and trucks are Joplin products, the former being the "tubs" and the latter the "ground cars" of the Tri-State zinc fields. They were purchased in Joplin, from the McNeal Machinery Co.

The inclined mounting of the bucket is a local adaptation made necessary by the very low height of the working face, which averages 52 in. and rarely varies more than a few inches. If the bucket is set upright on the truck, there remains only a few inches of clearance between the roof and the top of the bucket, which space is not sufficient for loading. If the height of the bucket is reduced, its capacity is proportionately decreased; and if its diameter is increased to add to its capacity with a lower height, the result is a shallow

Building dry-wall

The curved depression in the roof over the miner's head is formed by a "turtle-back." These are roughly circular slabs with a conchoidal upper surface and flat lower surface that conforms with the roof of the working. Their existence is hard to determine.

"tub" that is badly proportioned for handling and hoisting. The alternative is tilting the bucket; and a wooden cradle is built on the trucks, and the bucket is set at an angle of about 40 deg. This faces the mouth of the bucket toward the shovelers and gives a good opening to throw at when shoveling and loading, and no difficulty is experienced in putting a full load in each bucket. Handling and shoveling a heavy ore with headroom of only 4 ft. 2 in. is a clumsy procedure at best, but the workmen do surprisingly well when working with an inclined bucket. When loaded, the bucket is trammed to the shaft station, and when a sufficient number of loaded buckets has accumulated they are hoisted.

No sorting is done when shoveling the ore, except to throw out fragments of waste that may have broken or come down with the ore. These pieces of waste are shoveled back into the cut beneath the overhanging shale and are utilized in a later operation.

When the broken ore has been removed, the track is taken up and the props are knocked out from under the shale that was left in the hanging wall. This material is then barred down or, if necessary, shot down with a light charge, the slate holes having been

drilled for this purpose. The shale, which is locally referred to as "slate," comes down in large, flat slabs which may be as much as 10 or 12 ft. long, several feet wide, and from 1 to 1½ ft. thick. Usually they are smaller than this, as the shale is weak, and the shock of the fall may break a large slab in several places, or vertical cross breaks may exist that are similar to "cleats" in coal measures, and these form lines of weakness which result in fractures. The slabs fall on the waste that was thrown back under the slate when shoveling up the ore, and these waste fragments tilt the slabs forward and leave them in a position that makes them more readily handled. If they are allowed to fall flush with the flat floor and close to the new breast they are difficult to move.

The larger of these flat slabs are used for the base of a dry-wall that is erected about 6 ft. back from the new face. They furnish strength and solidity which cannot be secured by using smaller pieces and enable the wall to withstand the concussion and blows from the blasting of the next round. It is not especially difficult to move large blocks of slate into position, as the footwall is quite smooth and almost perfectly flat, and two or three men can usually move most of this material. Occasionally it is necessary to break up some of the larger blocks, and this is done with gads and striking hammers. Long, deep cracks and fractures can be made with a single gad, and by taking advantage of the bedding planes and cleats a block can be readily hewn to the shapes and sizes that are desired. The smaller slabs are used to complete the wall, and the surplus material, which is mostly fines and irregular fragments, is shoveled back of the wall and forms the fill or gob. When the wall is completed, care is taken to insure a tight contact with the roof. This is accomplished by wedging selected pieces of slate between the top of the wall and the roof and then driving them into place with a hammer. This strengthens the wall, insures immediate resistance to any settlement that may occur, and helps to keep the roof over the working face in good condition.

The thickness of the ore bed is the factor that determines the amount of shale to take down, and when mining a 30-in. bed of ore, about 22 in. of the hanging-wall shale is needed for the dry-wall and gob. The maximum quantity of shale that will build the wall and go into the gob is, of course, desired, so that maximum headroom may be secured, but a surplus must be avoided, to obviate the expense of tramming and hoisting waste. The waste which is produced in development workings is sometimes hoisted, as it is not always feasible to utilize it for filling.

View of shaft station

Hoisting iron ore in Joplin "tubs." The lowness of the back makes it necessary to tilt the bucket

Surface plant at the Franklin mine showing the headframe and ore bins and the shop building

The drilling of the new face follows the progress of the wall-building, and it is in turn followed by blasting and the removal of the ore; and the cycle of operations is then repeated. This cycle is illustrated in Figs. 2 and 3.

Subsidence occurs over the mined-out area, and may amount to as much as a foot of actual settlement. In general, it rarely occurs within 50 ft. of the face, and from that distance on, gradually reaches a maximum. To protect the shaft and the headframe and bins from settlement, a 50-ft. pillar was left around the shaft, and the other buildings of the surface plant were located on ground that will not be mined. When haulageways are maintained through mined-out areas, the subsidence makes it necessary to shoot down part of the roof to secure sufficient headroom. This operation is termed "brushing out the roof," and 2½ to 3 ft. of the roof is taken down. When the roof has been brushed out, the height of the mine workings is 6 ft. or more, but in all other parts of the mine the headroom is limited, and averages between 4 and 4½ ft.

Bell signals are regularly used in hoisting, and no attempt is made to follow the Joplin practice of hoisting without signals. When the empty bucket returns from the surface, it is lowered into position on a truck and the spring hook is unsnapped and hooked to the bail of a loaded bucket. The signal to hoist is then given, and the engineer raises the bucket slowly, so that the tub hooker may steady it as it comes into an upright position, and it is then pulled away.

The surface plant consists of headframe and bins and a building for blacksmith shop, compressor room, locker room, and wash room, store room, and office. The blacksmith-shop equipment includes an Ingersoll-Rand No. 4 drill sharpener and an oil forge. The compressor is an Ingersoll-Rand 12 by 10 ER-1 with a capacity of 355 cu.ft. It is driven by a 60-hp. electric motor.

The headframe is patterned after the "field-hopper" type which is in common use around Joplin. It is set over the shaft, and the upper portion is housed in. The hoist is placed in the room thus formed and is set just in the clear of the upward projection of the hoisting compartment and supported on a cross-braced derrick frame with 6 by 6-in. corner posts. This may be seen in the accompanying illustration. The buckets are hoisted through a hatchway directly in front of the

hoist. When a bucket has been hoisted, the engineer closes the door over the hatchway, hooks the bottom ring of the bucket and dumps it, rights the bucket, unhooks the dumping chain, opens the door, and lowers the bucket. The hoist was purchased in Joplin from the United Iron Works, Inc., and is a double-reduction, cone-clutch, electric-drive outfit with a 20-hp. motor.

Adjoining the headframe there is a two-compartment, seventy-ton ore bin, and the ore that is hoisted is dumped directly on a grizzly above these bins. This grizzly is set perfectly flat and serves as a sorting table as well as a screen. It has 2-in. openings. Beneath it is another grizzly set in an inclined position with ½-in. openings. The ore over 2-in. is hand sorted to a first and second class. Material smaller than 2 in. and coarser than ½ in. all goes to the second-class bin; and the material finer than ½ in. all goes to the first-class bin.

The ore contains about 48 per cent iron. and its general composition is represented by the following analysis:

	Per Cent		Per Cent
Fe_2O_3	69.17	S	.28
SiO_2	11.57	P_2O_5	1.726
Al_2O_3	3.92	CO_2 and H_2O	4.75
MnO	.19	Iron	48.42
CaO	5.8	Phosphorus	.754
MgO	2.27		

The ore is crushed, dried, and ground, and then used as a pigment in the paints and mortar colors that are manufactured by the owners of the mine. The value of this deposit of Clinton hematite in mortar colors is largely due to its high tinting power and uniform and permanent color value.

Obviating Troubles From Carbon and Copper Minerals in Cyaniding Gold Ore

At some of the mines in the Porcupine district in Ontario the gold is associated with a carbonaceous rock formation locally called "graphitic schist," says Charles Spearman in the April 24 issue of the *Journal* of the Society of Chemical Industry. This particular graphitic constituent acted as a very powerful precipitant of the gold after it had been dissolved in the cyanide solution. In some cases, where an ore averaging $12 to $15 a ton was being treated, the gold was practically all re-precipitated and passed out in the tailings. Experimental work by André Dorfman, at the McIntyre mine, showed that the ore, which contained 5 per cent of carbon, had the power to precipitate $274.80 per ton, or about $2.75 for each pound of carbon present in the rock. About 20 per cent of this precipitated gold went back into solution after continuous washing of the pulp, leaving a permanent loss of slightly more than $2 for each pound of carbon.

After various methods of solving the difficulty had proved ineffective or uneconomical, an oil treatment was adopted. A sample of carbonaceous ore with a precipitating power of 22 oz. of gold was pre-treated with different grades of crude oil or its derivatives. The effect of fuel oil or kerosene was that a reduction of 99 per cent of the precipitating properties of this carbonaceous schist resulted.

As a result of the above experimentation, it was arranged to feed about 3 qt. of kerosene per ton of ore direct to the ball mill, and the pulp after being ground to the usual mesh was treated by cyanide and lime. The consumption of cyanide was the same as in treating normal ore by the cyanide practice, no mechanical troubles such as frothing or foaming occurred due to the addition of the oil, and the ore, which assayed $13.60 in gold, when treated gave a tailing which assayed but $1. The function of the kerosene or kerosene distillate was to coat the particles of graphite so that they could not come into direct contact with the gold cyanide compound.

Another source of trouble in cyaniding refractory ores is the presence of chalcopyrite. This was remedied at one mine by mixing ore that was barren of chalcopyrite with some that was high in this mineral, the mixture being made so that the copper content did not exceed 0.4 per cent and the average much lower than this. The consumption of cyanide was increased from 25 to 40 per cent above that used with a normal ore with little or no copper present. This additional cost of cyanide, plus the additional small cost of refining the gold bullion, which contained considerable copper, was a great deal less than subjecting the ore to preliminary flotation for the removal of the copper sulphide as a concentrate, and the shipping of this to the smelter, plus smelter charges.

There is a field for the continuance of experimentation in the mechanical isolation of deleterious minerals in metallurgical work. For instance, it would be a great advantage to employ some agent that would envelop the copper and other sulphide constituents of the pulp, making them inert to the action of the cyanide solution, and at the same time leaving the particles of the precious metals free for cyanidation. The gold occurs more or less intimately associated mechanically with the chalcopyrite, and in such treatment there would naturally be a small quantity of gold remaining in the chalcopyrite thus isolated, unless very fine grinding was instituted. The introduction of a kerosene distillate into the grinding circuit would certainly isolate the sulphide particles without apparently isolating the gold from contact with the cyanide solution, and this treatment might go a long way toward solving the difficulties met in cyaniding copper and arsenical gold ores. It would probably take a slightly longer time to dissolve the gold, but this could be overcome easily.

Nickel Producers of Wales Are Active

The nickel-producing industry of the Swansea district in Wales is carried on by two concerns—the Mond Nickel Co., Ltd., and the Anglo-French Nickel Co., Ltd.—both located at Swansea, according to the U. S. Department of Commerce. Both firms are engaged in the importation of raw material (chiefly matte from Canada) and the extraction of nickel and byproducts therefrom. The products are disposed of both domestically and on foreign markets, the trade being about evenly divided between the two. The chief foreign markets for nickel sulphate are, in order Germany (165), France (155), and Japan (93), the figures indicating tons exported in the first quarter of 1925. For the metal, in the form of rondels and cubes, the chief markets are France (380), Italy (320), Germany (315), and the United States (200).

The nickel industry is apparently in very healthy condition, says the report. The Mond Nickel Co., by far the more important of the two concerns, has been almost steadily expanding its plant since its organization in 1900, and at present has under construction a considerable new addition.

Discussion

Price Quotations for Zinc and Lead

THE EDITOR:

Sir—On behalf of the Tri-State Zinc and Lead Ore Producers Association, representing producers and sellers of zinc and lead concentrates in the Tri-State district, we should like to have detailed information as to the manner in which the zinc and lead market reports (particularly the former) of the *Mining Journal-Press* are prepared, and also to inquire whether more complete market information could be furnished.

Your market summary gives, for each of these metals, a daily price at St. Louis or New York or both, and a weekly average price. These are, to quote your market page, your "appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of your judgment the prevailing values of the metals for deliveries constituting the major markets," for the usual price-basing points as indicated. We also note that "the quotations are arrived at by a committee consisting of the market editors of *Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce."

We should like to know in somewhat more detail the manner in which the zinc and lead quotations are arrived at. We have been told, at one time or another, that your committee visits the principal producers and agencies, with access in some cases to their books, and then combines the various reports so obtained to the best of its judgment. Will you please indicate to us the exact manner in which reports from different sellers are combined? Are they in all cases received with sufficient completeness so that daily, weekly and monthly average prices may be computed, and accurately weighted according to the tonnages sold on different days at the different prices? Could you also indicate to us what percentage of the total metal sold from week to week is covered by the various reports thus obtained by your market committee, and whether any of the larger sellers of metal do not furnish full data for use in your market summaries? In other words, are the quotations of the *Mining Journal-Press* based on information as to sales of zinc and lead which is 100 per cent complete for the entire country, or if, as would seem reasonable, this has not been possible, what proportion of the total sales do they in each case represent?

Another point concerning which we should like more specific information is as to the possibility that "wash sales," or other transactions not ordinarily considered to represent a legitimate market between a *bona fide* seller and *bona fide* buyer, may be included in the compilation of average prices. In the case of the zinc market in particular, with which we are most directly concerned, it is readily conceivable that the interest of certain sellers or dealers might be to lower the apparent price for slab zinc, as published in the press, below the actual market for metal sold in quantities, by means of such transactions; and we do know of certain cases where virtually no tonnage of metal has been available for purchase at the quoted prices. We should like to know just what safeguards, if any, you employ to eliminate mere nominal offers or transactions from your market data, and to limit them to *bona fide* transactions.

We realize that the questions which we are raising have in the past been the subjects of much discussion and at times of considerable controversy. We hope that we shall not be misunderstood. We do not question in the slightest degree the good faith of the market staff of the *Mining Journal-Press* in compiling its market report; but we should like to know in more detail what precautions are taken to prevent your published quotations from being influenced by reports designed to establish paper quotations rather than to represent the true market situation. We should also like to know more exactly, as indicated above, the extent to which the entire Prime Western zinc market of the country is covered by your market data, as a basis for certain constructive suggestions which we wish to make below.

This entire question of metal market information is of course of great importance to the zinc industry. It is of particular importance to the ore porducers of this district, from which is obtained most of the Prime Western zinc of the country, since the ores or concentrates are here sold to a considerable extent on the basis of the published metal quotations—not by contract based on such quotations, but through bargaining with the smelter representatives who base their offers on these quotations. There is a strong feeling among ore producers here that zinc quotations are given out to the press which are intended as a basis for buying ore in this district rather than for selling metal. At a recent meeting of the American Zinc Institute there was considerable discussion of the "fence" existing between the zinc ore producers and zinc smelters, and one point in this connection which has been strongly emphasized since is that the ironing out of difficulties between these two branches of the industry has little likelihood of accomplishment unless full information concerning the zinc smelting and selling end of the business is made available to the ore producers, in the same manner that the entire activities of the ore producers are now spread out as an open book before the zinc smelters. It would seem to us that in such a situation a journal of unquestioned standing such as yours might be of considerable aid.

Would it be possible for the *Engineering and Mining Journal-Press* to furnish to the zinc industry a more complete picture of the slab zinc market, in the form of data giving quantities of metal sold as well as prices? This would, we presume, depend in part upon how completely the market data furnished to you cover the zinc industry for the entire country, and the extent to which permission to publish detailed data could be obtained from zinc producers and dealers. What we have in mind is the publishing of complete records of metal transactions, omitting names of buyers and sellers, but giving for each day the quantity sold at each particular price quoted. This would give a complete picture of the

market such as is obtained in the case of grains and stocks, and is the sort of information we would expect if all transactions were conducted on an open metal exchange. In case the publishing of details as to quantities and prices for individual sales were objected to because certain of such sales might be identifiable, would it not be possible to state the total quantity sold each day and the weighted average price for the day, or at the very least to give this information for each week? It would also be very enlightening to know separately the quantities of Prime Western metal sold each week by actual producers and by dealers. As matters stand now, the ordinary ore producer or other individual interested in the zinc industry has but little idea as to the relative importance of the various published quotations; he does not know whether large tonnages of metal are sold at high prices and small or insignificant tonnages at the bottom of a decline, and he distrusts any representations made to him on the basis of the metal market. The only way to eliminate such distrust would seem to be the publication of full information as to both quantities sold and the prices corresponding thereto, of actual detailed facts instead of conclusions based upon such facts.

We appreciate that publication of full market information such as we suggest would involve considerable work; but it seems to us that this information should be obtained in any case if market reports are to be entirely accurate, and that this is an opportunity for a journal which can command the confidence of metal sellers to be of great service to an important metal industry. Furthermore, as indicated above, if misunderstandings and conflicts between zinc ore producers and smelters are to be minimized, it can be done only on a basis of full information as to what is going on in the industry; and the publication of this information would be an important constructive step. The carrying out of this suggestion by a trade association, such as the American Zinc Institute, or by any other organization which might include the various sellers of slab zinc, would be difficult and possibly questionable under the present anti-trust laws, but we know of no objections to its being carried out by a publication such as yours. Also, it would seem to us that if the large sellers of slab zinc, who are also the buyers of zinc ore in the Tri-State field, wish the ore producers of this field to believe that the quotations reported in the press actually represent the true and complete slab zinc market, they could best show good faith by co-operating in the preparation of full reports such as we suggest.

This letter has been approved by the board of directors of this association and comes to you as an expression of their sentiment. We are sending copies of it to the U. S. Bureau of Mines and the Bureau of Foreign and Domestic Commerce, which organizations we note are represented on the committee which prepares your market reports. We should also be pleased if you see fit to publish it in the columns of your journal.

Miami, Okla. TRI-STATE ZINC AND LEAD ORE PRODUCERS ASSOCIATION,
Julian D. Conover, Secretary.

Not Bingo Gold Mines, Ltd.

THE EDITOR:

Sir—We have just read the article appearing on page 777 of your issue of May 9 and regret that such a garbled statement as the first section of the column contains should appear in a paper that is widely read and so implicitly relied upon for its accuracy.

The meeting you refer to was *not* a meeting of Bingo Gold Mines, Ltd., but was a meeting of Bingo Mines, Ltd., a Canadian company which has some shares in this company. The Canadian company originally owned three of the mineral claims which this company now owns, and turned them over to this company for shares in this company. Immediately preceding the meeting of Bingo Mines, Ltd., the Canadian company, Mr. Myers and his associates, purchased control. Bingo Gold Mines. Ltd., is the company owning the properties at Herb Lake, and is a company formed in England.

Winnipeg, Man. BINGO GOLD MINES, LTD.,
CHARLES F. GRAY,
Board of Management.

Oil Shales and Hydrocarbon Veindikes

THE EDITOR:

Sir—I have expected to see some discussion in your columns of the letter "Hydrocarbon Veindikes and Oil Shales," published in the *Mining Journal-Press* of April 18, 1925. Can it be that your readers believe with Hiram W. Hixon that there is petroleum in oil shale?

It is difficult for one's imagination to follow the natural details of the processes involved by the theory he proposes for the genesis of oil shale. He speaks specifically of the large oil-shale region in western Colorado. Here the strata are flat and continuous for many miles. Some are indeed barren; others are of varying grades. Regardless of the grade of any stratum, however, it persists in its grade or quality very constantly. How could petroleum, bubbling from fissures in a sea bottom, because so uniformly disseminated? Would not the oil perhaps have saturated only a small extent of the mud bed next to the veins while most of the oil rose to the surface of the sea?

If we accept his theory for the enrichment of the mud, how shall we explain the fact that there is no petroleum, nor any remains of petroleum, in oil shale? It were more easy to conceive the oil shales as the sources of the contents of the veindikes than to conceive the reverse. A. J. HOSKIN.

Urbana, Ill.,

What a Prospector Should Know

THE EDITOR:

Sir—This does not refer to the claim grabber, schemer, grubstake eater, claim stock promoters and so forth—these are simply bunco men in mining disguise. The genuine prospector must know float rock and metallic ores of all descriptions. This requires some knowledge of mineralogy. When the float rock is found, he must trace it to its source; when found in place, he should recognize if it is a fissure vein or an irregular deposit, contact deposit, or a surface deposit; these veins and deposits are often faulted and displaced by movements of the earth's crust. To understand all these things and form a correct idea of his find, some general knowledge of geology is required. He must know how to mine, how to timber, to make a windlass, to build a cabin, to cook his meals without inviting indigestion, to hunt some, to catch a fish, to pack and saddle and take care of a mule or horse. A great deal of miscellaneous knowledge comes handy at some time or other. WILLIAM H. BAUR.

Silver Lake, Mont.

Consultation

Cyanide Plants in Northern Ontario

"I should like to have you give me the location of the Hollinger gold mine, together with information as to what railroad one uses to get there, and any other information that would be useful in making a trip of inspection to the mine.

"As I want to look into the latest cyanide practice, I should also like to know of any other cyanide plants which might be within reasonable reach by making a trip from here and return. Or, if you can suggest a trip that will yield more information than the one contemplated, I shall be greatly obliged if you will outline it."

The most interesting and accessible cyanide plants in the eastern half of the continent are without doubt those of northern Ontario and no mistake will be made in visiting them.

One can leave New York by the New York Central at 11 p.m., arriving at Toronto at 1:46 p.m. the next day. You then leave Toronto by the Canadian National Railway at 8:45 p.m. and reach Timmins at 6 p.m. the next day. There you will find hotel accommodation. The Hollinger and McIntyre mills are within walking distance and the other properties are easily reached by bus. The following cyanide plants, treating gold ores, are of interest:

Hollinger Consolidated Gold Mines, Timmins, Ont., A. F. Brigham, gen. mgr., 6,000 tons.
McIntyre Porcupine Mines, Schumacher, Ont., R. J. Ennis, gen. mgr., 1,200 tons.
Dome Mines, South Porcupine, Ont., H. P. De Pencier, mgr., 1,500 tons.
Vipond Consolidated Mines, Timmins, Ont., J. Mackintosh Bell, gen. mgr., 175 tons.
Consol. West Dome Lake Mines, South Porcupine, Ont., D. M. McPhail, mgr., 150 tons.

On the way back, over the same route, it is worth while to stop off at Kirkland Lake and Cobalt, a few hours by train south of the Porcupine district. At Kirkland Lake, reached by a branch line or by bus from Swastika on the main line, are several interesting, though smaller, mills. Among them are:

Wright-Hargreaves Mines, Kirkland Lake, Ont., 400 tons.
Lake Shore Mines, Kirkland Lake, Ont., 325 tons.
Tough-Oakes Burnside Gold Mines, Kirkland Lake, Ont., B. W. W. McDougall, mgr., 150 tons.
Teck-Hughes Gold Mines, Kirkland Lake, Ont., D. L. H. Forbes, gen. mgr., 100 tons.
Argonaut Gold, Argonaut, Ont., M. W. Summerhayes, gen. eng., 150 tons.

The above plants are all within walking distance of the town except the last named. All treat gold ore by cyanidation.

At Cobalt, 2½ hours ride south of Kirkland Lake, you will see concentration cyanide plants treating silver ore. Though you are principally interested in gold, it might be worth while to see at least two of the mills:

Cobalt Reduction Co., Cobalt, Ont., M. F. Fairlie, mgr., 150 tons concentrate.
Nipissing Mines Co., Cobalt, Ont., Hugh Park, mgr., 300 tons concentrate.

You will no doubt be most hospitably received at all of these plants, though it might be well to write ahead and identify yourself.

South African Corundum Grades

"Is it true that South Africa has the greatest reserve of corundum in the world? What varieties are produced there?"

Corundum fields in the Union of South Africa are the most extensive on record, according to A. L. Hall. They cover an area of 2,000 square miles in northern and eastern Transvaal. The commercial importance of this source of corundum was not realized until the war, when a shortage of abrasive material stimulated the development of the South African resources.

The following varieties are found in South Africa:

(*a*) Crystal corundum—this includes deposits occurring as loose crystals or crystalline fragments in the soil generally from the disintegration of corundum-bearing rocks. The bulk of the corundum placed upon the market is of this grade.

(*b*) Boulder grade—this variety is found in loose, scattered lumps, which on account of their high alumina content and consequent hardness have resisted disintegration.

(*c*) Reef corundum—a term applied to narrow vertical veins of corundum-bearing rock found in place. According to Hall, this variety is not marketed as such, but is used by one company as the principal source of raw material for the preparation of grain corundum. The bulk of the payable reefs contain from 20 to 40 per cent corundum.

Grain corundum is corundum that has received preparation and grading to reduce it to various commercial sizes. About sixteen grades are obtained, varying in size from 10 mesh to 100 mesh. Each grade contains about 95 per cent Al_2O_3.

At present one company, the Transvaal Grain Corundum Co., Ltd., has a plant to treat corundum-bearing rock, carrying from 15 to 60 per cent corundum. Crushing in a five-stamp battery, followed by jigging, tabling and magnetic separation, is the practice.

Water of Plasticity

"What does water of plasticity mean when referred to clays? I have occasionally noticed the term used in specifying the qualtities of a clay and am anxious to determine its exact definition."

Water of plasticity, as its name implies, refers to the amount of water required to make a pulverized clay or shale plastic. By plastic is meant a working consistency for the material, so that the clay can be readily kneaded. Naturally, some latitude is permitted in a determination of the point at which the desired consistency is attained, but at best the water of plasticity is an approximation. There is no standard measure for this quality, so far as we know, and clays are generally rated as having a plasticity in varying degrees —high, moderate, or low. Water of plasticity is generally denoted in per cent. Thus, if a clay has 27 per cent water of plasticity, 27 per cent by weight of water has been added to the clay to give it the desired plasticity.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

H. FOSTER BAIN has accepted the position of secretary of the A. I. M. E. and soon will sever his connection as director of the U. S. Bureau of Mines. He succeeds F. F. Sharpless.

Directors of the Calumet & Arizona Mining Co. have voted to curtail C. & A. copper output by 1,000,000 lb. and that of New Cornelia by 500,000 lb.

Valuation of iron mines in Michigan has been reduced $3,400,000, as compared with 1924, by the state tax commission.

The Idaho Copper Corporation has entered suit against Stewart Campbell, state mine inspector, for $100,000. Campbell criticized the company's promotion methods.

Investment of Japanese capital in mining properties in Mexico is reaching considerable proportions.

Ore reserves at the Keeley silver mine in Ontario decreased 1,400,000 oz. during the last year.

Shipments of zinc concentrate to Belgium from the Coeur d'Alene district have started in spite of the protest of the Montana Railroad Commission.

The Mammoth mine on the United States S. R. & M. Co. has been shut down permanently, and the smelter will cease operation in August.

Technicians in the U. S. Geological Survey have been automatically retired, although they desired to remain.

The International Smelting Co. is continuing to acquire mining property in the Tintic district, in Utah.

C. & A. and New Cornelia Will Curtail Copper Output

Directors Take Action — Reason "Ordinary Business Prudence"—Rich Ore in Junction Shaft

The boards of directors of the Calumet & Arizona companies have voted to reduce the output of Calumet & Arizona by 1,000,000 lb. per month and that of New Cornelia 500,000 lb. or more, based on recent outputs. The companies acted wholly on their own initiative, according to the directors, their course being suggested by ordinary business prudence.

The resignation of General John C. Greenway, for fifteen years general manager of Calumet & Arizona and New Cornelia, has been accepted by the directors. He tendered his resignation some time ago but action upon it was deferred. It is stated his successor will be announced shortly.

High-grade ore continues to be opened in Calumet & Arizona in the Bisbee district. Rich ore has been encountered in the bottom of the Junction shaft and ore developments in and about the Campbell and Cole shafts are likewise encouraging. Ore also has been opened in the Crescent claim near the old Wolverine and Arizona property and it is regarded as a favorable area.

The largest electrically operated pumping plant in use was recently placed in commission at the Junction mine, raising water to surface from the twenty-third level. The shaft collects practically all the water in the Bisbee basin, known as the Bonanza Circle, and because of this fact Denn-Arizona probably will resume operations in the near future. The property has been idle for several years. The shaft was recently repaired and now that the water problem has been taken care of operating conditions are favorable.

A. S. & R. Co. Opens Office in Seattle

OWING to the increased activity in mining in the Northwestern States, British Columbia and the Territories of Alaska and Yukon, the American Smelting & Refining Co. has again opened an office at Seattle and has placed Lewis A. Levensaler in charge. The company maintained an office for many years in Seattle previous to 1921, when it was closed on account of the general slackness of business.

Empire Mines Co. to Resume

The 2,000-ft. shaft of the Empire Mines Co., in the Tintic district, in Utah, is being put in shape for a resumption of activity, and work will be begun immediately on the company's property, consisting of 1,000 acres adjoining the Mammoth and the Iron Blossom. Operations are to be centered on exploration of well-mineralized fissures on the 1,800 level.

Keeley Ore Reserves Decreased by 1,400,000 Oz.

Production 1,880,352 Oz., Largest on Record—Mill Heads Now $12 Per Ton

The annual report of the Keeley Silver Mines of South Lorrain, Ont., for the year ended Feb. 28, 1925, shows a production of 1,880,352 oz. of silver, an increase of 300,000 oz. compared with the previous year and the highest annual production in the company's history.

The gross value of the company's output was $1,428,874 and profits were $835,306, an increase of $226,000. The total cost of production was 32.567c. per ounce and the average price received for silver, including revenue from Cobalt and other sources, was 75.916c. per ounce.

During the year dividends amounting to $480,000 were paid and liquid assets now stand at $1,241,137, an increase of almost $400,000 as compared with the previous year. Ore reserves decreased from 3,742,000 oz. to 2,337,000 oz., but the report states that the mine is in good physical condition and the ore reserves remain in a healthy state, according to J. McIntosh Bell, managing director for the company.

Development done last year in the western part of the property opened up a new and unexplored section of ore-bearing ground which is considered to be full of promise. The concentrator is operating satisfactorily and making a good recovery by means of tables and flotation equipment.

Michigan Copper Production 12,450,000 Lb.

Refined copper production in the Michigan district in May was 12,450,000 lb., estimated, a slight increase over output for April. The Calumet & Hecla group of mines, including Isle Royale, a subsidiary, produced 8,350,000 lb., estimated as follows: Ahmeek, 2,900,000; Calumet reclamation plant, 1,600,000; conglomerate and Osceola lodes, 2,500,000; North Kearsarge, 400,000; Tamarack reclamation plant, 200,000; Isle Royale, 750,000. Mohawk's output was 1,500,000; Quincy, 1,000,000, and Copper Range, 1,600,000. The Tamarack reclamation plant, which was in process of adjustment in May, will do better in June, probably bringing its production up to 500,000 lb. This copper and that produced by the Calumet reclamation plant is cheap metal, as it can be recovered and sold at a cost of less than 9c. per lb.

Low-Grade Gold Ore Reported in Magdalena District

A group of Yuma, Ariz., business men, with whom are said to be associated San Francisco mining interests, are engaged in the development of a large low-grade gold property in the Magdalena district of Sonora. A fair tonnage of gold ore is reported to have been developed by diamond drilling, and a still further tonnage is believed to be awaiting measurement through further drifting at depths of from 300 to 400 ft. Diamond drilling was done in some parts of the property as far back as 1914, but revolutionary troubles necessitated a cessation of the work. Assays of general samples have shown between $4 and $5 gold per ton for the whole deposit. A part of the ore, it is reported, may be economically mined by steam shovels.

International Smelting Co. Options More Tintic Property

Option to purchase the Addie Mining Co.'s property, situated in the Tintic district at Eureka, Utah, has been taken by the International Smelting Co., and first payment of $5,000 made. The purchase price stipulated is $100,000 or 10c. a share for the company's capitalization of 1,000,000 shares; $25,000 is to be paid in December, 1926, and the remaining $70,000 in December, 1927. The company binds itself to pay a royalty of 20 per cent on all ore shipped between the date of the first payment and the time when the full amount of the purchase is to be made.

This purchase is in conformity with the International Smelting Co.'s policy of securing undeveloped claims in the East Tintic district. In addition to the Addie group, the company has acquired an option on the East Tintic Coalition group, part of the old Yankee and other claims constituting a strip of land over one mile in length and extending to the Tintic Standard estate. Installation of a hoist at the Yankee shaft, through which operations will be conducted by the International in its new territory, has already begun.

H. Foster Bain to Become Secretary of A. I. M. E.

Resigns as Director of Bureau of Mines to Take New Post—No Successor at Washington Mentioned

H. FOSTER BAIN will become secretary of the American Institute of Mining and Metallurgical Engineers. Although no formal announcement has been made, it is learned from the best authority that Mr. Bain will sever his connection with the U. S. Bureau of Mines, of which he has been director for four years, and succeed F. F. Sharpless as secretary of the Institute. Mr. Sharpless, while resuming his important interests in the field of mining, will continue to devote a large part of his time to the Institute, in association with Mr. Bain. The selection of an active assistant will, it is understood, be left to the new secretary, so that he will have a free hand in the conduct of the office.

H. Foster Bain

Prior to assuming the position of director of the Bureau of Mines in 1921, Bain had served as assistant director for a year during the World War. He was editor of *Mining & Scientific Press* from 1909 to 1914 and of the *Mining Magazine* in London during 1915 and 1916. His editorial experience is looked upon as a big asset in his new position.

There has been a gradual decrease in membership of the institute in recent years; and although several factors outside the control of the Institute contributed to this end, a strengthening in numbers and in interest among the members of the profession is hoped for as a consequence of the coming of a new administration.

No consideration is being given at this time to the selection of a successor for Mr. Bain. This will await a decision in the matter as to the transfer of the bureau from the Department of the Interior to the Department of Commerce. Since it seems very likely that this transfer will be made, the selection of the new director then would fall to Secretary Hoover.

Comstock Merger Milled 26,000 Tons During April

The Comstock Merger Mines Co., operating on the Comstock Lode, near Virginia City, Nev., milled 26,000 tons of ore during the month of April. Of this total 10,677 tons was mined from the Middle Mines section and the remainder from the Gold Hill section, formerly the property of the United Comstock Mines Co.

Development is reported as 2,133 ft. for the month of April. The main haulage tunnel was advanced a total of 411 ft., which leaves 1,060 ft. to drive to connect the two headings. The Hale & Norcross shaft, which is to be connected to the main haulage tunnel, was sunk 154 ft. during the month, leaving 175 ft. to go to reach the elevation of the haulage tunnel.

The Overman shaft is being retimbered and repaired and is complete to the 900 level. As soon as the 1,200 level is reached, development will be started into Belcher and other adjacent workings.

Lead-Zinc Ore at Red Bird

Operators of the Red Bird mine, at the junction of the Salmon and Pend Oreille Rivers in British Columbia, about 100 miles north of Spokane, are doing much surface work now that the snow is off the hills. The vein is large and the values good, according to F. R. Wolfle. The ore is of a shipping grade, oxidized, containing lead, zinc and some silver.

Iron Mine Valuations Lowered to $110,349,165 in Michigan

The Michigan Tax Commission has completed its annual task of going over the assessed valuations of the iron mines of the state, and the lists for the four counties in which iron ore properties are located are complete. Reductions were made in all of the counties because of the conditions of the ore market and ore depletion.

The total shows that the valuation of all of the ore properties is $110,349,165, as compared with $113,734,656 in 1924. The figures by counties for the two years are as follows:

Range	1924	1925
Gogebic	$45,932,758	$44,683,000
Dickinson	5,833,000	5,461,000
Iron	26,418,145	25,124,000
Marquette	35,560,753	35,081,165

Chino Has New Electric Shovel

A new electric shovel has been added to the equipment at the Chino Mines of the Ray Consolidated Copper Co. in Santa Rita, N. M. The machine is a Model 92 Marion shovel of the railroad type, equipped with 3½-yd. dipper; tractors will replace the standard railroad trucks with which it was equipped upon arrival.

The machine is giving satisfactory service since put in operation about the middle of the month. The freedom from smoke, condensed steam, and sparks—characteristic of steam shovels of similar type—is a factor in the efficiency of operating.

Coeur d'Alene Zinc Shipments to Belgium Started

Interstate Commerce Commission Disregarded Protest Against New Low Rate—Several Contracts Made

The first shipments of zinc concentrate from the Coeur d'Alene district, Idaho, for export to Belgium left Kellogg on May 19 for Portland, there to be transferred to steamship for delivery to destination by way of the Panama Canal. The shipments were the product of the Star mine, operated by the Sullivan Mining Co., the stock of which is owned equally by the Bunker Hill & Sullivan and Hecla Mining Company. The concentrates are consigned to the Vielle-Montagne Zinc Co., Liége, Belgium, which recently entered into a contract for the entire zinc output of the Star. The Belgian company has also secured contracts for the zinc product of the Highland-Surprise on Pine Creek, Tamarack & Custer, and the Success mining companies. The Belgian company is in the market for all the zinc obtainable in the district, and probably will be able to secure additional tonnage, particularly from the Pine Creek section.

In anticipation of zinc shipments to Belgium, the railroad company a few weeks ago announced the following export rate on zinc concentrate from Coeur d'Alene points to Portland: Ore valued at not over $30 per ton, $3.50; $40 per ton, $3.75; $50 per ton, $4; $60 per ton, $4.25. Announcement of these rates was followed by a protest filed with the Interstate Commerce Commission by the Montana Railroad Commission, alleging that it was detrimental to the smelting interests of Montana and generally to American industry and labor. The Interstate Commerce Commission was asked to suspend the rates pending an investigation.

It is assumed, generally, that the protest was made on behalf of the Anaconda Copper Mining Co., the only purchaser of Coeur d'Alene zinc until the Belgians entered the field. Evidently the Interstate Commerce Commission disregarded the protest, as the export rates went into effect on May 18 as scheduled and shipments are being made under them.

Will Continue Exploration of the Russell Vein

Marsh Mines Consolidated, at Burke, Idaho, has issued a circular to stockholders announcing that through the courtesy of the Hecla Mining Co., arrangements have been completed for continuing exploration of the Russell vein. The scene of operation will be the No. 3 level of the Hecla, which is 300 ft. lower than last work done. Besides affording greater depth on the veins, this privilege provides even greater facilities for waste disposal and greater convenience for operations in general. By attacking the Russell vein on this lower level, where oxidation and leaching are less, it is expected to disclose an ore shoot of commercial importance. Edward Pohlman is president of the company.

Steal 25 Tons of Tin from Bonded Warehouse

ON SUNDAY, May 17, burglars entered a bonded warehouse in New York City, an official warehouse for storing tin, and stole twenty-five tons of pig tin. A reward of $1,000 has been offered by the owners, the Peerless Tube Co., of Bloomfield, N. J., for information that will lead to the recovery of the metal. No matter how long after the theft takes place, if it can be proved that the metal was stolen, the purchaser will be held. The marks on this metal are as follows: "484 pigs A M C 89." It undoubtedly will appear in smaller packages than the original 110-lb. pigs.

Ore in Eagle & Blue Bell

Gratifying results are being achieved in the development of the new orebody on the 1,350 level of the Eagle & Blue Bell mine, near Eureka, Utah. In the main drift high-grade ore has been followed for more than 20 ft. and a raise has cut into the ore for 15 ft. This deposit, the principal values of which are silver and lead, is believed to be the same as that which was productive on the 1,100 level. Drifting will be continued on the lower levels of the mine to open up the same deposit. Ore is being mined on the 2,000 level of the Eagle and Blue Bell, but in another section of the property.

Oliver Company Will Ship 2,000,000 Tons From North Forty

Although a court decision to settle the famous "north forty" suit between the village of Hibbing and the Oliver Iron Mining Co. has not been handed down, the Oliver company has continued work and has removed 3,000,000 yd. of the 15,000,000 yd. of stripping necessary to expose the ore. The 350-ton shovel that has been stripping on this forty all winter has been moved back close to the north boundary line, has dug down 30 ft. into the ore and it is expected will load 2,000,000 tons during this shipping season. Two 100-ton railroad type shovels are busy on clean-up work and stripping to clear the ore ready for the big shovel, but heavy stripping is not expected to start again until next fall. The top of the stripping bank on this forty is now about 200 ft. north of where the First National Bank formerly stood.

Several iron mines on the Mesabi Range in Minnesota were affected by the 50c. cut in the price of iron ore this spring. The Dean mine at Buhl which has been shipping about 400,000 tons per season is closed down; the Warren mine at Hibbing recently taken over by the M. A. Hanna Co. is not working. The Mariska mine of the Bowe Burke Co. at Gilbert is loading nothing but stock-pile ore and the Susquehanna mine at Hibbing has just commenced loading after a month of shipping season has gone by. Several other mines have reduced forces but are still shipping ore.

Stewart Campbell Is Sued for $100,000 by Idaho Copper

His Criticism of Promotion Methods Destroyed Market for Shares, Is Charge

Stewart Campbell, state mine inspector for Idaho, was served on May 21 with a copy of the $100,000 damage suit filed against him in federal court at Boise by the Idaho Copper Corporation of New York. The complaint alleges that Mr. Campbell went outside his official duties and, violating his oath of office, issued a statement pertaining to the advertising and the workings of the Idaho Copper Corporation which was willful, false, malicious and defamatory. The company further alleges that this statement destroyed the market for its stock and brought it into great public disgrace and disrepute.

April 24 last, the complaint alleges, Campbell issued a statement directed against the plaintiff company, quoted in the complaint as follows:

"Advertising matter being circulated in sale of stock is grossly misleading and in conflict with Idaho laws. This department requests that in behalf of the investing public and the honor of your exchange that this stock be removed from listing and trading until such time as this company complies with all necessary laws and until statements relative to the mine are confined to the facts."

This, the complaint avers, was signed by Campbell and sent by wire to the Boston Curb Exchange.

The company declares that no advertising matter had been at that time circulated in the sale of stock as was alleged by the mine inspector.

On April 14 last, the complaint alleges, Campbell issued a statement concerning the property of the company and its business, and mailed it to Timothy J. Dacey, secretary of the Boston Curb Exchange. This letter, according to the complaint, was communicated to the governing officials of the exchange, and on April 16 was published in newspapers. This contributed to the destroying of the share market.

Mr. Campbell had nothing to say following the service of the complaint except that he would take the matter up with the Attorney-General.

Leadville Mines Co. Mills 25-Oz. Silver Ore in Nevada

The Leadville Mines Co., operating near Gerlach, Nev., is sinking its main shaft below the 700 level. The bottom of the shaft is now 60 ft. below the 700, and will be continued to the 850 level, at which point a station will be cut and drifting started. On the 700 level the north drift is out more than 600 ft. from the shaft, and oreshoots developed and stoped on upper levels have been found to continue to that elevation without material change in size or grade of the ore.

The flotation plant is operating continuously on 25-oz. silver ore containing some lead, and producing concentrates that will average about $200 per ton.

Goldfield Production for First Quarter $30,035 Gross

Bullion tax reports to the county assessor of Esmeralda County, Nev., for the first quarter of 1925, show production to have been 682 tons of ore, with a gross value of $30,035.05.

The greater portion of this production came from leasers on the property of the Goldfield Consolidated in Goldfield, which company received royalties amounting to $3,516.75. The Tonopah "76" company reports royalties received from the West End Consolidated Mining Co., which is operating its Tonopah property under lease, as amounting to $185.26.

Mammoth Smelter to Shut Down in August

The United States S. R. & M. Co. has permanently suspended operations at its Mammoth and Sutro mines in Shasta County, Calif., and the Kennett smelter of the company will be shut down for dismantling in August, after the stocks of ore and the larger and better orebodies in the Keystone mine have been mined. The smelter is at present getting some tonnage from the Mountain Copper Co. The closing of the smelter will leave the copper producers without any market closer than Tacoma, though this will be of immediate interest to only the Mountain Copper Co., as it is the only other active producer.

There still remains unmined in the district a considerable known tonnage of low-grade "ore," and there are fair possibilities of developing additional bodies of high grade, but the present markets are not sufficient incentive, and the closing of the smelter will discourage further exploration. The further development of differential flotation may offer sufficient advantage to revive the camp under more favorable conditions.

Dease Lake Placer Diggings Goal of Gold Seekers

THE STIKINE RIVER now is free from ice, navigation has started, and the rush to the new Dease Lake placer gold diggings in the Cassiar district of northern British Columbia has commenced. Already 250 men are in the field and more are leaving by every boat up the river from Wrangell, Alaska. The Provincial Government has established a deputy recorder's office at the foot of Dease Lake, and has placed H. B. Campbell, formerly of Williams Lake, in the Cariboo district, in charge.

There is a deputy recorder's office at the head of the lake and a gold commissioner's office at Telegraph Creek. It is thought that these officers will be able to take care of the situation. The government has sent additional provincial police into the district and has taken preliminary steps toward forming a townsite within the area. The Canadian Geological Survey and the Provincial Department of Mines each have made arrangements to have a survey party in the field during this summer.

Will Reopen Silver Trail

The Silver Trail Mining Co., idle for nine years, will be reopened immediately under the management of J. Richard Brown. This property, which has shipped $125,000 of ore, is in Stevens County, Wash., north of the Old Dominion mine, and three miles north of the Chloride Queen. The directors expect to ship ore within sixty days. They estimate that $75,000 worth of ore is ready to go. At the same time an extension of the tunnel will be driven 1,000 ft., and the shaft will be sunk an additional 300 ft.

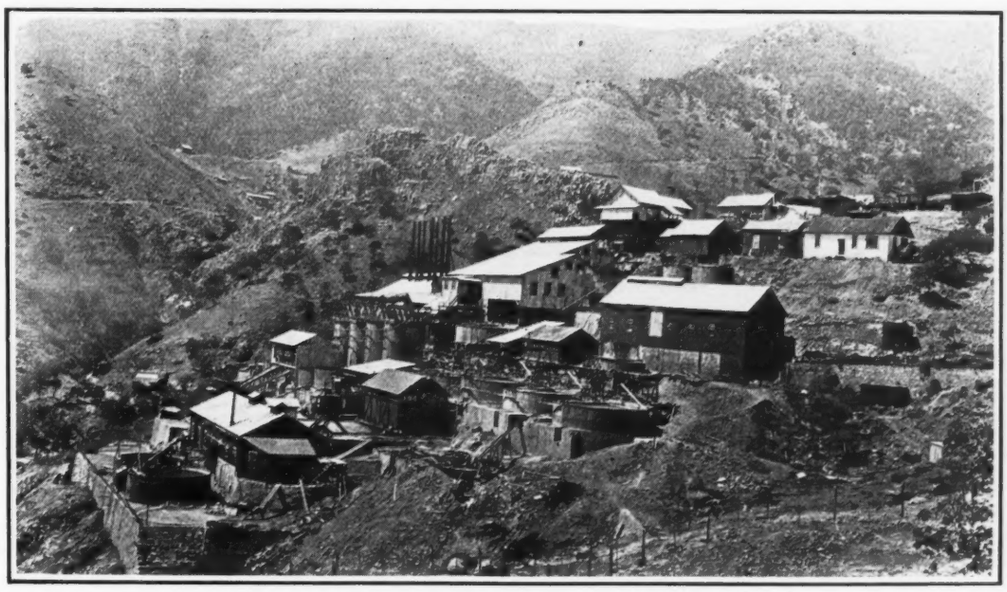
Granby Copper Cost 11.53c. During First Quarter

The Granby Consolidated Mining, Smelting & Power Co. has announced that during the first three months of this year it produced 8,887,751 lb. of copper and made an operating profit of $1,040,148, which, however, does not allow for the payment of interest on bonds, depreciation, and depletion. The cost of copper production was 11.53c. per pound, which compares with an average cost of 10.6c. for last year; the increase is due to the fact that, owing to the absence of the usual mid-winter thaw and consequent shortage of water, steam power had to be used instead of water power during part of the period. The hydro-electric plant is in operation again now.

New Aluminum Plant in Germany Has Hydro-electric Power

A yearly output of 12,000 metric tons of crude aluminum has been estimated for the Inn Works, a new aluminum plant erected in southeastern Bavaria, Germany, about eight miles southwest from Muhlsdorf, according to F. T. F. Dumont, consul-general at Frankfort-on-Main. It is not expected that this amount will be reached before 1926, because of technical difficulties. The site includes the Jettenbach-Toging dam, and it is estimated that 20 per cent of the cost of production is for the generation of electric current. As the Erftwerk, Lautawerk and Bitterfeld works, the only other plants producing crude aluminum in Germany, utilize electric current derived from coal, the importance of the new plant to the German industry is apparent.

Germany's output of crude aluminum in 1924 is stated to have been about 20,000 metric tons; in 1923 it was 16,100 tons. Domestic consumption in 1923 required 13,700 tons, although consumption was below normal, owing to economic conditions.



Plant of the Dolores Mines Co. in Chihuahua

With a capacity of 200 tons per day, this mill and cyanide plant recovers 96 per cent of the gold and 87 per cent of the silver in a hard quartz ore.

Washington News

By Paul Wooton
Special Correspondent

Wood and Cross Automatically Retired From U. S. G. S.

Both Would Like to Remain—Interior Department Ignores Discretionary Powers of Law

George M. Wood, for many years editor for the Geological Survey, has fallen victim to the new federal retirement law. Whitman Cross, one of the Survey's best known geologists, also has been retired. In each of these cases, the man was retired against his will. These men are enthusiastically interested in the work they have been doing and each is in a position to render the best service he ever has given.

The policy of the Interior Department is to apply the retirement provision without making use of the discretionary powers lodged in the head of each department. The argument for making no exceptions is that it saves great loss of time to all administrative officers who otherwise would have to listen to numerous appeals on behalf of each employee who reaches the retirement age. It also is contended that in most cases it is in the interest of efficiency to observe the age limit. It is not denied that there are some very outstanding exceptions.

Those who do not agree with this policy say that no good administrative officer throws away discretionary powers which the law grants. To follow an arbitrary rule simply is following the line of least resistance, which in this case is depriving the public of services of great value, it is contended.

U. S. Geological Survey Puts Dunlap at Joplin

With the idea of giving the Tri-State zinc and lead district a better statistical service, J. P. Dunlap, the head of the metals section of the Geological Survey's mineral resources division, will make Joplin his permanent headquarters in the future. This arrangement will keep the Survey in close touch with that important metal-producing area. In addition it has been found that personal contact is almost necessary in securing returns from a district in which there are so many small producers.

Government Official Sees Growing Output of Lead

A reasonably steady price of 8c. is calculated to bring out more lead from domestic sources than is generally supposed. This is the observation of one of the government's specialists who has just returned from an extended field trip. His contacts with the lead producers revealed to him that operating programs call for extensive future development, which is somewhat at variance with the popular impression that the last of the lead is about to be mined.

Strangely enough, the alarming reports as to the imminence of an acute shortage in lead seem to originate with the consumers.

Despite the fact that progress seems distressingly slow in working out the problems of recovery from complex ores, this official fully expects to see a steadily increasing lead output from Western mines. Nevertheless he thinks we should continue to look hard for additional deposits abroad.

Pine Creek Mine Owners Hope for Rail Extension

Think Tonnage Warrants Building of Seven-Mile Line—Union Pacific Sends Chief Geologist

The successful treatment of complex zinc-lead ores on Pine Creek in the Coeur d'Alene district, Idaho, by the Constitution Mining & Milling Co., followed by the entrance of the Vielle-Montagne Zinc Co., of Belgium, into the field to contract for zinc concentrate, has infused life into the Pine Creek section, where there is greater mining activity than ever before.

It is not only the properties having complex ore that are attracting attention, but important deposits of lead-silver free from zinc or with zinc without "complicated" features have also been developed. With this showing of actual tonnage and an assured market for the metals, the Pine Creek Mine Owners' Association has made an appeal to the O.-W. R. & N. Company (Union Pacific System) to complete the branch railroad, started in 1917, to the Constitution mine, a distance of about seven miles. Evidently the railroad company has been impressed with the figures submitted by the Pine Creek mine owners, for Dr. Boyle, of Omaha, chief geologist for the Union Pacific, has been requested to make a personal inspection of the mines on Pine Creek, which is taken to mean that if his investigations confirm the representations made regarding available ore for shipment, the branch line will be completed this summer.

Comanche M. & R. Co. Expands Operations Near Bishop

The Comanche Mining & Reduction Co., a close corporation controlled and financed by Judge Erskine M. Ross of Los Angeles, according to Charles A. Palmer, manager, has completed the installation of additional mechanical equipment and is now operating at its various mines on Blind Spring Hill, 35 miles north of Bishop, Calif., on an increased scale, with a view to tapping the many orebodies below the horizons which were productive years ago.

The Comanche shaft is being sunk from the 700 to the 800 level. Following completion of this work, a drift will be advanced north 400 ft. and another to the south 200 ft. These projected workings will give a depth of 150 ft. below the old stopes. Sampling of the "fills" indicates a good tonnage of ore ranging in value from $10 to $20 a ton.

The Kerrick shaft, sunk years ago to a depth of 650 ft., has been cleaned out and retimbered, and is now being continued to 820 ft.

Announce Details of Lena Goldfields-Soviet Agreement

Chief Shareholders Approve—Arbitration Provided to Settle Disputes—Soviet Promises Protection

The directors of the Lena Goldfields, Ltd., after consulting their representatives, who have returned from Moscow, and perusing the concession agreement signed on April 30, 1925, in Moscow, by the president of the chief concession committee, Mr. Piatakoff, acting under special authority of the Council of People's Commissaries of the U.S.S.R., have outlined the conditions.

The main features of the agreement, which has been reached with the full knowledge and approval of the chief shareholders of the company, are as follows:

"The properties covered by the agreement are known as Lenskoie, Sissert, Revda, and Altai. The Lenskoie undertaking is given to the concessionaire for a period of thirty years as a going concern, with all machinery, materials, implements, and stores thereon, as well as with full supplies for the next year. The concessionaire has full right of further developing all the mining resources of this gold-bearing district.

"The Sissert and the Revda mining districts (iron and copper mines and plants in the Urals) are taken over as going concerns, and also the Altai property (including zinc, lead, copper, silver, and gold mines) during a period of fifty years. With the concession there are also coal mines in the Kusnetz Basin, as well as anthracite collieries in the Urals.

"The concessionaire is protected as to timber, water power, and transport facilities, and also has the right of importing for the first seven years free of duty all machinery and equipment necessary for the works.

"There is a clause as to minimum production which has been worked out on conservative lines by the experts on both sides, and with regard to royalties and taxes, the liabilities of the concessionaire have been clearly defined and limited.

"The Soviet Government agrees to give the Lena special military protection for their enterprises, workmen, and employees, and for produce en route, while the relations with local labor have been clearly defined. The concessionaire has the right to engage foreign workmen and specialists, and such foreign citizens working on their territory will be specially protected.

"The agreement provides that the whole of the property transferred to the concessionaire by the government shall not be nationalized, confiscated, or otherwise taken away from the concessionaire.

"All disputes between the concessionaire and the Soviet Government are to be settled by arbitration before three judges, one of whom shall be appointed by the Soviet Government, one by the Lena, and the super-arbitrator to be elected by the parties from among professors of the Royal Polytechnic in Stockholm, or the Freebourg Mining Academy."

London Letter

By W. A. Doman
Special Correspondent

Lena Goldfields Agreement, Not Ratified, Basis of Speculation

Big Profit on Publication of Abridged Terms—Mawchi Mines in Burma Reopened

London, May 19—Considerable interest has been aroused in the City over a statement issued by the directors of Lena Goldfields with reference to the agreement made by the company's representatives with the Soviet authorities in Moscow. The agreement itself is not published, and apparently only half the case is shown. The company gets its properties for thirty years, and is given military protection; but the price it has to pay is not set out. Rumor is busy, and says that 25 per cent of all produce has to be handed over, together with an onerous obligation similar to that of the Harriman concession, which is that if the property should be taken back again by the Soviet authorities, heavy payments of one sort or another must still be made. The agreement has still to be ratified. It is further alleged that while the negotiations were proceeding certain people bought a large block of shares at about 3s. 6d., and took advantage of the publication of the abridged terms of the agreement to secure a handsome profit. Consequently, if there is no ratification, it would appear that some one has done well out of the deal.

The Rhodesia Broken Hill Development Co. announces that the big power scheme at Mulungushi is now in operation and is supplying the mine. Pumps are being installed, and on completion in about a fortnight the concentration plant will be started and the whole of the mine load, apart from the pilot zinc plant, will be run from Mulungushi, thirty-five miles away. At first 2,500 hp. will be produced, but an extension to 150,000 hp. is in mind.

Owing to the death of Jack Doyle, the dredge manager of the Pato and Nechi mines, the directors have appointed Alec Watson to the position, and he is about to proceed from London to the properties.

After having been shut down for several years, partly owing to lack of working capital, the Mawchi Mines (Burma) are to be reopened. The people taking it in hand are the Anglo-American Corporation of South Africa and the Consolidated Mines Selection. The plant is being reconditioned and brought up to date. Milling is expected to commence by the end of August. Estimates have been worked out on the basis of wolfram at 10s. per unit, but the present price is 15s. K. D. R. Morrice, of Henry Bath & Son, Ltd., has been appointed chairman.

Another discovery has been made on the property of the Rhodesia Congo Border Concessions. Mimbula is fourteen miles south of N'Changa, and there is a very extensive low-grade copper deposit (two miles) similar in formation to that at Dambo. In one place the width is 300 ft. with an average value of 1.85 per cent. In another place the average assay is 2.8 per cent copper.

Some time ago I mentioned the speculation in Boulder Perseverance, which, so far as I could gather at the time, was based upon the results of a couple of bore-holes. This has now proved to be correct, and only a pocket has been struck, so that the shares are down again.

It is stated that a Finnish company has been formed with a capital of 6,000,000 Finn marks, to exploit gold deposits along the Ivalo stream in Finnish Lapland. For many years small quantities of gold have been discovered here, and an attempt at thorough exploration is now to be made.

Japanese Invest in Mexican Mining Properties

Considerable Japanese capital is being invested in Mexican mines. Recently a group of Japanese incorporated the Union Minera Mexico y Japan under Mexican law. The new company purchased the Alicia mine, situated in the municipality of Oquitoa, State of Sonora. The property is known to be rich in high-grade silver-copper ore and the production already shows a good increase under its new management. Several smaller mines in the states of Sonora, Sinaloa, and Durango have been purchased recently by Japanese. In these properties Japanese laborers are rapidly replacing native miners, and this action is causing some discontent on the part of the labor element in some localities of the Pacific coast region of Mexico.

Spanish Mineral Conference Would Cut Taxes on Mining

The National Conference on Minerals in Madrid has published provisional conclusions which propose certain remedies for the retarded development of mining in Spain, according to Augustin W. Ferrin, Consul at Madrid. Some of these recommendations are for the elimination or reduction of taxes, including the tax on shares of mining companies, surcharges on mineral production, taxes and import duties on explosives, import duties on mine timbers, export taxes on ores and minerals, and transportation taxes. It was also recommended that more modern mining machinery and methods be introduced, that nationalization of mining industries be promoted, that mining chambers of commerce be given representation on the permanent commission of the Council of National Economy and that mining interests have special recognition in the negotiation of new commercial treaties.

Will Work Star Mine

Operations at the Star mine in Cherry Creek, in eastern Nevada, are being resumed under the direction of J. W. Walker. The tailing dump of the Exchequer and Star mines will also be treated. Ely capital is financing this venture. A new concentrator is being installed to treat the tailings.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Amulet Gold Mines Official Reports New Finds

Copper, Zinc, Gold and Silver Reported —Dome Orebody Shows Up Well —Ore 52 Ft. Wide

Toronto, May 30—The president of the Amulet Gold Mines, Ltd., operating in northwestern Quebec, reports a new and important discovery carrying copper, zinc, gold, silver, and the platinum metals. The discovery is new and distinct from the older orebodies and up to date has been proved over an area 40 by 75 ft. Much greater dimensions than this are indicated, but it will be some time before sufficient work has been done to prove the full extent of the new find. So far the other discoveries on the property have been comparatively low in gold, but the one just made is more nearly like the Noranda ore.

An extensive diamond-drilling campaign will be entered into and tunnels will also be run into a hill 150 ft. high, which apparently contains a large quantity of ore. The Amulet property lies about four miles to the north of the Horne group of the Noranda Syndicate and in addition to the latest discovery has indicated five or six other copper-bearing orebodies. Northwestern Quebec is gradually developing into a copper-gold district. So far the majority of the purely gold discoveries are not proving to be of great importance. This statement is not intended to condemn the field as a possible gold-mining district, as in all probability good gold discoveries will be made, but the surface finds to date have been somewhat erratic and in most cases have not persisted to any great depth.

Recent developments at the Dome property in Porcupine are understood to have been very favorable. The orebody in the igneous formation, which was mentioned at the annual meeting as having just been discovered by diamond drilling, has now been intercepted by a crosscut from the fourteenth level. It has been drifted on for a length of 270 ft. and, where crosscut, showed a width of 52 ft. It is understood that values are higher than the general average of the mill ore. This orebody is in the Dome Extension ground a considerable distance away from the main shaft, and it is reported that a winze will be sunk at a depth of 400 ft., which will permit of more rapid and economical progress in development.

Judgment to enforce a mortgage against the property of the Great Northern Power Co. has been granted by the courts on the application of the Montreal Trust Co., which is trustee for the bond holders to the amount of $850,000, on which there was a default in interest of $29,750 due May 1. The company has a line into Porcupine, but was unable to secure sufficient customers to pay expenses. It was expected that Matachewan would demand a large amount of power, but so far this has not materialized.

Societies, Addresses, and Reports

Mining Law Revision—A Study of Proposals

U. S. Chamber of Commerce Natural Resources Production Department Makes Report—Opposing Views Presented

A STUDY of the various proposals that have been made in regard to revising the United States mining laws has been issued in pamphlet form by the natural resources production department of the U. S. Chamber of Commerce. W. DuB. Brookings, manager of the department, points out, in a foreword, that interest has been stimulated recently in the subject by resolutions passed by some of the important mining associations calling for investigations and reports on certain phases of the mining laws. The information given, which has been assembled and prepared by Francis Winslow, of the department's staff, has been obtained from many sources.

The first few pages of the report are devoted to a brief statement of the issues involved, and to a description of the way in which mining claims are located, with a comparison of the theory of the law and the practice under it. Following this is a brief history of the agitation for revision of the present law, which has been in force since 1872.

The remainder of the report contains a compilation of the arguments pro and con which have been advanced concerning each of the proposed changes. These are submitted regardless of their relative importance. The most important of them, it is generally conceded (the report says), are the "Abolishment of Extralateral Rights" and the "Abolishment of Discovery." The other items are of varying degress of importance. The "Cash Payment in Lieu of Assessment Work" and the "Locations to Conform to Public Land Surveys" provisions are theoretically desirable, but not vital to the industry. Since they are the basis for a good deal of the opposition to revision, they could well be modified or left out. The "Provision for Larger Mill Sites" is desirable, but of minor importance.

The provisions "Claims Must Be Patented Within Seven Years," "Stricter Requirements for Marking Claims," "Size of Claims," and "Location Notices to Be Filed With the United States Land Office" are of secondary importance and in general meet the approval of the mining industry.

The last provision, "Appeal to the Courts From Decisions of Land Office Officials," is a matter of importance which meets the approval of most mining men. It is worthy of consideration, but need not necessarily be tied to a revision of the mining laws.

General Arguments Favoring Revision

1. The United States has never had a well-considered mining code. The present laws are fragmentary. They are a piece-work of individual statutes usually passed as a measure of expediency to meet a specific situation.

2. Dissatisfaction has existed for many years with the mining laws.

3. Such law as exists is scattered and difficult of access.

4. The general land laws are now in process of codification and in time the mineral laws will be codified. This should be done primarily by mining men rather than as an incident of the general codification by lawyers.

5. The present laws were not planned to apply to many of the kinds of mineral deposits, nor to the mining conditions, which are found today.

6. Vein mines are not today our largest producers. Copper, lead, and zinc ores occur in massive deposits for whose location the act of 1872 was not intended to provide.

7. The present laws discourage prospecting and the development of new mines.

8. As the ultimate consumer the nation should be anxious to remove the burdens that hamper precious metal mining.

9. Under the proposed revision the prospector could go upon lands that are classed as non-mineral. His titles would be more secure and it would be easier for him to obtain financial support.

10. Laws should be judged by their effect on the whole country and industry.

11. Many abuses have been perpetrated by unscrupulous locators of land under the mining laws.

12. The present laws are a direct encouragement to misrepresentation.

General Arguments Opposing Revision

1. It is the first step towards some sort of a leasing system for metallic minerals.

2. It will extend the regulatory powers of the Land Office and similar organizations, which will increase the annoyances inflicted on persons engaged in mining development. Operations in the natural forests are already too much annoyed and hampered by governmental interference.

3. The mining industry is tired of regulation and restriction. It prefers to work its way back to prosperity through laws that are well understood, even though imperfect.

4. The proposed revision has ignored the individual and designed a law for big organizations. It is really a land-grabbing scheme fostered by the larger mining companies.

5. In a new district a few men could locate an immense tract of ground and retard the development of the district.

6. It will work against the prospector.

7. We have not yet reached the point where the small man can be ignored. Mines are first found and partly developed by prospectors and small operators. The large companies will not look at a property until this work has been done.

8. The pioneer cannot be expected to operate properties. He does his part by finding and developing the mine. The law should recognize this and give him first consideration.

Abolishment of Extralateral Rights (Apex Law)

Under the present law the locator has absolute possession of the surface of his claim. He is given all lodes or veins whose apexes (tops) are on his claim or beneath it. He has absolute possession of the portions of such lodes that lie between two vertical planes passing through the end lines of his claim. He may follow his portion of the lode wherever it goes in its downward course. Even when it passes beyond the vertical extension of his side lines he may still follow it. This is the "extralateral" right. But he has no rights to lodes which pass through his property if they "apex" elsewhere.

It is proposed to abolish extralateral rights as to all future locations. All previous locations retain their extralateral rights and in addition are given all the lodes included within their vertical planes that are not covered by any existing extralateral rights.

Arguments Favoring. The law will not be retroactive. Present rights will be increased. Almost everyone favors this abolishment. The law is not suited to the orebodies which are now found. Many types of orebodies are now known which the law did not consider.

Our public lands in the West are the only areas in the world where this law is in force. The Germans tried it in the seventeenth century. It was abandoned in British Columbia. A number of our Western mining districts have abandoned it by mutual consent. Such agreements are difficult to consummate since one non-conformist may precipitate lawsuits on a whole camp.

The law of extralateral rights has always been a source of litigation. The leading cases selected by Morrison as authoritative in the construction of the apex law furnish no measure, even of the number, to say nothing of the importance and cost, of the contests caused by that law. To the direct costs of the long "apex" trials themselves must be added the great expense of preparation.

Under the proposed law an examining engineer would not have to be a mining lawyer in order to determine what the rights of the various properties were.

Satisfactory locations could be made by the ordinary man using crude methods—pacing and pocket compass. In case of error only a small strip or vein would be lost. Under the present system the error might throw the apex outside the boundary line and destroy the essential value of the location.

There are cases where the state and federal courts differ. There are points upon which the U. S. courts of appeal in different circuits are in direct conflict.

It was not the intention of the framers of the act that the accidental covering of an undiscovered apex with

a claim located for the convenient working of another and altogether separate vein would be used as a legitimate basis of title against the real discoverer who had developed the vein by shaft or tunnel. But the act grants a locator mining rights upon a vein which he has not discovered and at times even upon a vein which someone else has discovered.

There is much confusion as to what is an "apex." Prior to the act no one had ever heard of it. Dictionaries said it was a "point," the statutes said it was a "top," the courts finally declared it to be an "edge," and then defined this "edge" as a "surface."

It sometimes happens that the proper mining of an ore deposit is considerably hampered. According to the act, the underground rights are limited by such surface conditions as the position of the boundaries of the claim and the course of the apex.

As regards the extralateral portion of the lode, the right does not cover mining unless it can be done wholly within the vein—no matter how narrow it may be. Should the owner cross-cut through the land of another, even from a shaft on his own ground to reach the extralateral portion of his own vein, he will be guilty of trespass.

It is argued that if the "apex" provision is abolished for future locations there will be a great deal of confusion due to having two systems of law in operation. But we already have two systems working when quartz claims adjoin placer claims and also when either adjoin agricultural lands, and they work without undue friction.

Many injustices would be avoided. Abolishment of the extralateral provision will also tend to simplify the mining laws. There will be no discrimination between the lode and placer claims. Tunnel site locations will no longer be a source of annoyance.

The uncertainty of mining titles and the constant risk of litigation has made mining investments less attractive and undeveloped properties more difficult to dispose of. It has made the prospector one of the chief sufferers.

It has been stated that many foreign operators and investors feel that in purchasing mines they would prefer Mexico with all its revolutionary troubles to the United States with the danger of encroachment on underground rights by unscrupulous neighbors.

Arguments Opposing. The extralateral right or "apex" law was built from the customs and practice of the miners in the early days in the West. It is the result of a process of natural selection.

Thirty or forty years ago it could have been changed without much confusion. It is too late to change it now. There is probably no considerable region unprospected now where a camp of importance is likely to occur.

The courts have passed on all important phases of the situation. A change in the law would tend to promote more disputes rather than less. Confusion would result from two systems of titles. In relocations of lapsed claims in the midst of present locations there would be many arguments.

The "apex" law is now so well understood that locations are made with it in view and its hazard is taken with open eyes. In comparison to the number of claims staked "apex" cases are few.

"Apex" cases form only a small percentage of the total mining litigation. Out of 5,808 decisions listed in Morrison's Mining Reports from 1883 to 1906 only 115, or 1.9 per cent, concerned the "apex" law.

When a miner has discovered, and, by his work, developed a dipping vein, and worked it on the incline to the vertical plane through his boundary, he should not be stopped by this wholly artificial obstacle, and see another without labor and without price reap the advantage of his discovery and development. It is not only unjust but it is also economically inexpedient.

Abolishment of the Discovery Requirement

The present law requires the discovery of valuable mineral in place as a condition preliminary to location.

It is proposed that the discovery of valuable mineral in order to locate and hold a mining claim, subject to limitations, shall not be necessary, but a discovery must be made before a patent can be obtained; that a claim may be held for five years without discovery and may be held for a further period, not exceeding five years, by the payment of $50 per acre per annum; that a person claiming to have made a discovery must file a sworn statement to that effect and there must be verification of the discovery by a United States deputy mineral surveyor; that under certain conditions mining claims may be located, with or without discovery, on public land classified as non-mineral; and that one discovery is sufficient to support the holding and patenting of a maximum of 160 acres in contiguous claims.

Arguments Favoring. The provision would still permit the prospector to take up claims on which he has found an outcrop of ore, as at present.

There is much ore which does not outcrop. The prospector is not equipped to find it. There are many large irregular orebodies such as the "porphyry coppers," orebodies covered by alluvials, or orebodies deeply buried under a rock capping. It is proposed to open up the way to deep prospecting for such ore deposits by allowing temporary possessory title to the lands.

It would be possible to explore the ancient unconformities such as the Pro-Cambrian surface between the Grand Canyon and Jerome, Ariz. Such projects are beyond the ability of the individual.

There is now no adequate legal system for acquiring title to lands needed to finance and develop the large orebodies which do not outcrop. At present title is acquired to such properties through subterfuge and elaborate legal fiction because this is the only possible way.

Where it is necessary to make heavy expenditures in advance of a real discovery there is a title risk involved which mining men and investors are reluctant to take.

One should be able to locate and patent ground which, while not necessarily of direct value for its mineral content, is needed for the protection and exploitation of known deposits, as well as for more certain title to ground of probable but undemonstrated mineral content of potential value.

The present practice is really much the same as the proposed. Also if a promoter can show a fee-simple title, it is easier for him to raise money.

As far as the United States is concerned, it is a matter of indifference whether the claimant secures title by patent proceedings or continues his assessment work. His title is valid in either case. Forcing land to patent, which makes it private land, gets the federal government out of the way and gives the people of the Western states authority which they now possess only to a limited degree. If the state wishes to force this private land into use it can do so through its power of taxation.

The payment of $50 per acre annually in order to hold land without discovery is sufficiently strict to ensure that no land will be held long under this provision. Also, since a real discovery is required before a patent is issued, the land will either be thoroughly explored or will revert to the public domain. Also, if the law of extralateral rights is abolished, it is obvious that the discovery requirement must be abolished.

Arguments Opposing. Thhe need is more apparent than real. Public opinion gives sufficient protection to any locator while he is actually working. Also, at present courts hold that prior to discovery a locator is protected to the extent of his actual possession. Ample protection could be provided by amending the present statutes so that while a locator is at work for the purpose of making a discovery, the land shall not be open to location by others.

Locations before discovery would enable locators to tie up large areas of the public domain for indefinite periods. Fraudulent acquisition of title to water power, timber land, and townsites will make such frauds easier.

It will facilitate the taking up of "near pay" ground for speculative or obstructing purposes. Also, no activity on government land will be safe from extortion. As soon as a body of government timber is advertised for sale it could be located as mining claims and heavy demands made for the use of the ground.

After a strike is made in almost any district, the abandoned locations are revived and adjoining claim lines moved. This practice will be increased if no discovery is required and the old claims will have a better chance of winning if at one time they had a legal basis. In conflicts between mineral claims and homesteads the latter must prove the land non-mineral. If no discovery is required, this will be harder.

Fifty dollars per acre annually after five years is too high a charge for holding land. Also, making discovery a prerequisite to location tends to limit the number of claims located by an individual.

Size of Claims

Under the present law a lode claim must not exceed 1,500 ft. in length nor 600 ft. in width. Certain states and dis-

tricts reduce these maximums somewhat.

It is proposed that every full mining claim shall be located in the form of a square containing 40 acres but that 10-acre square claims may also be located and that the area and the form of other fractional claims may be governed by available areas.

Discussion. In Mexico a claim contains about 2½ acres, while in British Columbia it is 1,500 ft. square. Both systems seem to work satisfactorily. Mining men in the neighboring sections of the United States favor the nearest system. The proposed combination of the two systems permitting the location of either large or small claims and the basing of the assessment and other charges on a rate per acre seems to be satisfactory to most of those concerned.

Stricter Requirements for Marking Claims

Under the present law, "the location must be distinctly marked on the ground so that its boundaries can be readily traced" (R.S. 2324). The law of the United States does not define the kind of marks that shall be made or where they shall be placed. Different states have adopted various regulations.

It is proposed that the marking of the location shall include placing a permanent monument extending not less than 2 ft. above the ground at each corner of the claim. Also that in cases of conflict between monuments and descriptions the monuments shall govern.

Sentiment is generally favorable to this provision.

Locations to Conform to the Public Land Surveys

Under the present law the lode claim is usually a parallelogram 600 ft. by 1,500 ft., with the discovery lode running down the center. The claim may extend in any direction. Placer claims, however, must conform as nearly as practicable to the rectangular subdivisions of the Public Land Surveys and are limited to an area of 20 acres.

Under the proposed law, mining claims must be laid out in the form of squares, on cardinal lines. On surveyed land they must coincide with the lines of the public survey. The full mining claim is 40 acres, but the location of 10-acre claims is permitted. It is also suggested that the locator be allowed to lay out his claim as he does at present, but that if it is located in accordance with the public land survey no further survey will be necessary.

Arguments Favoring. A comparison of a claim map of any of our Western mining districts with that of any of the Eastern or foreign districts will show the theoretical desirability of this provision. Also this would bring mineral locations in accord with existing laws as regards the disposition of all other public land, including placer land.

Arguments Opposing. Not one lode claim in a thousand conforms to the public surveys, since lodes seldom run due east or due north. The prospector is not a surveyor nor can he be expected to have one with him. Immense areas are still unsurveyed. In unsurveyed country it would require a survey party working ten days to conform to this regulation.

Location Notices to Be Filed With the United States Land Office

The United States statutes at present say nothing as to the filing of location notices. The various states have adopted regulations on this subject and it is usually required that duplicates of the location certificates be filed for record with the nearest county clerk or recorded within a certain time after the claim is staked.

It is proposed that the notice of location of all claims shall be recorded within ninety days of the date of location, in the United States Land Office for the district in which located.

Discussion. The government does not, today, possess either records or maps showing what portions of its public mineral lands have been appropriated by valid mining locations, which, being held under possessory title, do not now belong to that domain. This has led to much confusion and the infliction of unnecessary expense and hardship upon those whom the laws were intended to benefit. By maintaining a federal record anyone will be able to find out what land is still open for location.

In opposition, it is stated that the state laws will have to be changed to avoid duplication of records; that the expense will be increased since the local officers will need larger quarters and more clerks; and that the United States Land Offices are often far distant from the mineral locations.

Cash Payment in Lieu of Assessment Work

The present law requires that $100 worth of labor or improvements be expended annually on each claim until it is patented. This usually amounts to $5 per acre.

Arguments Favoring. This provision has been found satisfactory in British Columbia. It is permissive only, and anyone who prefers to do assessment work may do so. In requiring assessment work it was the intention of the law to provide in this way for the development of the properties. Conditions sometimes arise that make it difficult to do the assessment work. Assessment work is usually wasted, often futile, and sometimes unnecessary. Often it is dishonestly done. There is no inspection system to ensure that the proper amount of work has really been performed.

Arguments Opposing. It will not help to get the mines developed. Too many claims lie undeveloped now because of this privilege. They are patented and can be held indefinitely by the payment of a small annual tax.

Claims Must Be Patented Within Seven Years

Under the present law a locator can have his claim patented when he cares to show that he has done $500 worth of work on it. He is not compelled to patent it and he may continue to hold it indefinitely as long as he keeps up his assessment work.

It is proposed that final entry and payment for all mining claims shall be made within seven years from the date of the original location, except in the case of extension of the exploring right where no discovery has been made, when twelve years is allowed.

Discussion. It is felt that if one cannot do anything with a claim in seven years then he should step aside for someone else who can. There should be a limit to possessory title to mining land. Also it sometimes happens that a claim is held until the deposit is worked out and the mine abandoned.

In opposition it is urged that a provision requiring patent in seven years would work a hardship on the small owner who finds his time limit expiring and has no funds to defray the expenses of patent.

Providing Larger Mill Sites

Under the present law, where nonmineral land not contiguous to the vein or lode is needed for mining or milling purposes, it may be taken up and patented to the extent of 5 acres by complying with the regulations as to survey and notice, and by paying the usual $5 per acre.

Under the proposed law, where additional land is required for mining or metallurgical purposes, entry may be made thereof to the extent of 10 acres. In certain cases a larger area may be entered with the approval of the Secretary of the Interior, and paid for at the rate of $10 per acre. It is further provided that the claimant shall have only a surface right to such area.

Arguments Favoring. The present 5-acre mill sites are too small for modern mining and metallurgical operations. Some of the large companies use over 1,000 acres.

Arguments Opposing. The present 5-acre mill site is usually sufficient. To allow unlimited areas to be taken up by paying $10 per acre would mean that large sections of the public domain would be acquired by important interests.

Appeal to Courts From Decisions of Land Office Officials

Under the present laws the decisions of the Land Office and the Secretary of the Interior are final and cases cannot be carried further. The supporters of the existing system feel that since the government is disposing of its own land it has the right to determine the conditions under which it is disposed of and to see that the stipulations are fulfilled. It is also felt that to allow an appeal to the courts would mean that every case which was turned down by the Land Office would be appealed.

Arguments Favoring. The questionnaires sent out by the technical societies show that almost all of the mining fraternity are in favor of this reform. They feel that it is contrary to the general spirit of our institutions to take away from any citizen property rights to which he considers himself justly entitled under the law, by the mere finding of an appointed government official. Serious injustice is often done without any remedy at law to the defeated applicant. The enactment of such legislation was especially recommended to Congress in a Presidential message by William H. Taft.

The report closes with a classification of ore deposits to demonstrate their variety, many of which do not take a position with regard to the surface which permits the apex law to be applied.

Men You Should Know About

Gordon Wilson has acquired an interest in, and taken over the management of, the San Vicente Mining Co., at San Vicente, Sinaloa, Mexico.

W. Lee Heidenreich returned to New York on May 21 from Colombia, South America, where he has spent several weeks in mine examination work. He left the following day for Cartersville, Ga.

Dr. Forrest Kerr left Vancouver on May 27 in charge of a survey party for the new Cassiar gold district, in northern British Columbia, in the interest of the Canadian Geological Survey.

J. A. Ettlinger, consulting engineer and geologist for the Ray Consolidated and Magma Copper companies in Arizona, is in Tonopah, Nevada, on geological work for the Tonopah Extension Mining Company.

Gerald Fitzgerald and **W. R. Smith**, of the staff of the U. S. Geological Survey, have arrived on the northern side of Brooks Range in Alaska and have begun additional work on the surveys of Naval Petroleum Reserve No. 4.

Walter A. RuKeyser, mining engineer, of New York City, recently returned to New York from a trip to Ecuador and Colombia on professional business. He expects to leave for Sudbury, Ont., shortly. He was accompanied by **Reginald Dempster** to South America.

H. G. Washburn, formerly manager of the Federal Lead Co., at Flat River, Mo., and for the last year mining engineer for the Utah department of the American Smelting & Refining Co., at Salt Lake City, has been appointed assistant general manager of the Federal Mining & Smelting Co., at Wallace, Idaho.

Arthur Crowfoot, superintendent of the concentration division of the Phelps-Dodge Corporation at Morenci, recently completed a series of three two-hour lectures at the University of Arizona on "Present-day Practice in the Concentration of Low-grade Sulphide Ore." The lectures were arranged by Dean G. M. Butler for the junior and senior mining students.

C. Wythe Cooke, of the U. S. Geological Survey, is in Alabama and Mississippi for several months' field work. **W. P. Woodring** is continuing field work on the oil resources of the Elk Hills, Calif. **James Gilluly** is at Huntington, Utah, where he will be joined by **E. T. McKnight** and **S. S. Nye**, who will assist him in his work on the San Rafael Swell.

Dr. H. I. Jensen, formerly geologist in the Northern Territory for the Australian Commonwealth Government, afterward on the Queensland Geological Survey and later in private practice in Australia, was to leave Queensland on Dec. 24 for the mandated territory of New Guinea, as geologist to the Ormildah Oil Development Co., Ltd. He expects to be absent from Australia about nine months.

Melville F. Coolbaugh, metallurgical engineer, of Golden, Colo., has been elected president of the Colorado School of Mines, at Golden. Mr. Coolbaugh was professor of chemistry at the school in 1917 and 1918 and since that time his chief work has been in developing and perfecting the sulphating process for treating lead-zinc ore by roasting and leaching. A plant using this process is now in operation at the Durango smelter of the A. S. & R. Co.

Edward I. Williams, mining engineer and superintendent of the General Chemical Co.'s mines at Monarat, Va., where pyrite has been mined for the company, has resigned to become superintendent of the smelter of the Tennessee Copper Co., at Copperhill, Tenn. He assumed his new duties on June 1.

Edward I. Williams

W. A. J. M. Van Waterschoot Van der Gracht has resigned as president of the Marland Oil Co., of Texas, so as more evenly to divide his time among the various subsidiaries of the Marland company. In the future he will make his headquarters in Ponca City, Okla. Mr. Van der Gracht is a member of the board of directors of the Marland Oil Co. **F. Park Geyer** was elected president of the Marland Oil Co., of Texas, and assumed that office on April 16.

General John C. Greenway, general manager of the mines of the Calumet & Arizona Mining Co. for twenty years, has tendered his resignation to the board of directors and it has been accepted, effective July 1. His successor is to be named at an early date. General Greenway will devote all of his time to private interests and to the Ahumada Lead Co., of which he is the managing director. He is interested in water-power development on the Colorado River and Diamond Creek. He will make Ajo, Ariz., his home during the greater part of the year and will continue as a director of the New Cornelia Copper Co., which is located there. General Greenway has been active in mining since 1899, when he started with the Oliver Iron Mining Co., at Ishpeming, Mich., and he was at Coleraine, Minn., for the same company prior to going to Arizona.

Obituary

Julius Kellerschon, chief geologist for the Oliver Iron Mining Co., died in New York on May 2. He was in the employ of that company for twenty-seven years and held the position of chief geologist for ten years.

Dr. John Mason Clark, state geologist and paleontologist of New York, died of pneumonia at Albany on May 29 at the age of sixty-eight. About 1,000 men, including leaders in the scientific world, were present at the funeral, which was held in St. Peter's Church. A sketch of his career will be published in an early issue of *Mining Journal-Press*.

N. H. Emmons, 2d, mining engineer, lost a race against death, in which an airplane, wireless and the telephone figured, when he died in a Winnipeg, Canada, hospital on May 25. When word was received in Winnipeg on May 22 that Emmons was ill without medical attention in the mining district of northern Manitoba, the Canadian air force sent an airplane from the Victoria Beach station to convey him to Winnipeg. News of the airplane's departure was sent by radio to the mining camp, and the sick man was hurried to Long Lake. There he was placed aboard the plane. Six hours after word of his illness had been received he was in the hospital, but his illness had advanced too far for him to be saved.

Dr. Donaldson B. Dowling, of the Canadian Geological Survey, died suddenly in his home in Ottawa on the night of May 26 from heart disease, at the age of 67 years. He had an international reputation as a geologist and was an authority on the coal and petroleum resources of Canada. Dr. Dowling was born in Camden Township, Addington County, Ont., in 1858 and was graduated from McGill University, Montreal. He joined the staff of the Geological Survey in 1884, and his earlier years were devoted to exploration work in northern Ontario, Manitoba, and Saskatchewan, the results of which contributed much to the development of the resources of those provinces. Subsequently Dr. Dowling specialized in the study of the coal and oil deposits of western Canada, and his researches led to the discovery of important coal and petroleum fields. The finding of an artesian water supply in southern Alberta, rendering irrigation possible, was also the result of his investigations. In 1921 Dr. Dowling made an examination of the petroleum discoveries in the Fort Norman area. He was a member of the Geographical Board of Canada and the Dominion Fuel Board, and belonged to several scientific societies, including the Geological Society of America. He was a Fellow of the Royal Society of Canada, and in 1917 was president of the Canadian Mining Institute.

Recent Technical Publications

Reviews, Abstracts, and References

For Engineering Writers

The Composition of Technical Papers. By H. A. Watt and P. B. McDonald. McGraw-Hill Book Co., New York. Price $2.

As a practical and helpful guide to correct, sensible, and up-to-date technical literary composition, the second and revised edition of the joint endeavors of Watt and McDonald is the best work on the subject that has come to our desk. It was written primarily for the student—as a textbook—but most editors, copyreaders — and proofreaders and printers, too—would profit greatly by a painstaking and careful study of this volume. Ten or twenty years after graduation, few professional men retain a sufficient residue of their intellectual equipment, as seniors, to pass an entrance examination. "The Composition of Technical Papers" affords material with which the engineer and editor may "brush up," so to speak. Who may boast that he does not need to? Pages 126 to 143 are devoted to the presentation of 150 weak sentences. Rewriting them will prove to be a salutary exercise not alone for students but for those who make a profession of literary work. Chapter XI, on Business and Professional Letters, though brief, is timely and "true talk." What the authors say therein, every one who writes business letters ought to know. Most such letters, despite a quite general realization of the need for reform, bear evidence of the necessity of understanding the principles and heeding the warnings recorded in this chapter.

Messrs. Watt and McDonald have shown excellent judgment in including in their volume, as examples of forceful statement and clear thinking, some of Lincoln's letters, President Wilson's address to the officers of the Atlantic Fleet on Aug. 11, 1917; Premier Clemenceau's short speech to the German delegates at the Peace Conference at Versailles, in May, 1919, and the reply thereto of Count Brockdorff-Rantzau, head of the German delegation. The record of these historic episodes may with profit oft be reread—lest we forget. W. N. P. REED.

Underground Surveying — "Underground Orientation by Exact and Approximate 'Alignments' of Plumbwires in One Shaft" is discussed in a 26-page paper by L. H. Cooke in the *Bulletin* of the Institution of Mining and Metallurgy for April. There are also several pages of discussion of previously published papers on ore-sorting and handpicking, mining and metallurgical practice in South Africa, and hygrometry for deep mines. The paper on underground orientation can be obtained for 2s. from the offices of the Institution, Cleveland House, 225 City Road, London, E. C. 1.

Western Australia — The Annual Progress Report of the Geological Survey of Western Australia for 1923, 38 pages, is now obtainable on request from the Survey, at Perth.

Bonus System—"The United Verde Copper Company's Bonus Methods" are discussed by W. V. DeCamp, 9 pages, in *The Mining Congress Journal* for December. (Washington, D. C.; price 30c.) A general consideration of bonus methods is followed by a description of the practice that has been found particularly successful in the underground and steam-shovel operations of this Arizona company.

South African Asbestos—A. L. Hall, in an 8-page article in *The South African Journal of Industries* for November (Pretoria; price 6d.), describes "The Asbestos Resources of the Union of South Africa," giving the available varieties with particulars of their distribution and mode of occurrence, the methods used for recovery and grading of the mineral, the extent of the local consumption, the output to date, a list of producers, and a bibliography.

Zinc Smelting — "Oxidation of Zinc Vapor by Carbon Dioxide" is the title of Technical Paper 336 by B. M. O'Harra, 22 pages, obtainable for 5c. from the Superintendent of Documents, Washington, D. C. The object of the investigation here reported was to determine accurately the ratio of carbon dioxide to carbon monoxide required to oxidize zinc under conditions approaching as nearly as possible those in the ordinary zinc condenser. The oxidation of zinc vapor by carbon monoxide is theoretically possible, though ordinarily of little practical importance.

Classification—The Fahrenwald hindered-settling classifier described in our issue of March 21 was discussed more at length by A. W. Fahrenwald in U. S. Bureau of Mines *Reports of Investigations*, Serial No. 2,618, 11 pages, obtainable on request from the U. S. Bureau of Mines, Washington, D. C. The title of the paper is "Hindered Settling Classification in Relation to Table Concentration of Idaho Lead-Zinc Ores."

South African Platinum—*The South African Mining and Engineering Journal* has recently issued a special platinum number with full information about all phases of the South African platinum deposits and their exploitation. This was the issue of March 21. In the succeeding issue, for March 28, appears much that was crowded out of the other, and the two form an excellent and timely review of the situation up to date. Price of the March 21 issue, 1s., and of the March 28 issue, 6d.; Johannesburg.

Industrial Oxygen — The increased use of oxygen and its production on a commercial scale at low prices are receiving much attention nowadays. The U. S. Bureau of Mines is or was working on the subject of widening the use of this element in metallurgy, and liquid oxygen explosives have attained some standing. In *The Journal* of the South African Institution of Engineers for April is a 20-page paper by J. H. Dobson on "Industrial Oxygen and Important Uses." Price 2s.; Johannesburg.

Patents

Zirconium Extraction—No. 1,535,687. April 28, 1925. Otto Ruff, Breslau, Germany. Zirconium-containing material is heated with a haloid salt of zirconium or with materials forming such a haloid salt, at a temperature sufficient to volatilize the resultant haloid salts of the contaminating elements.

Slag Skimmer—No. 1,535,731. April 28, 1925. F. B. McKune, Hamilton, Ont. A tapping launder from a furnace to a ladle is arranged with a bypass to a slag pot, the bottom of the bypass being at a higher level than the main launder. The discharge ends may be raised or lowered.

Antimony - Lead Separation — No. 1,535,743. April 28, 1925. B. C. Stannard, Berkeley, and C. W. Haffey, Selby, Calif., assignors to American Smelting & Refining Co., New York. Commercially pure antimony oxide is recovered from lead bullion when present in excess of a stable fixed percentage, by melting the bullion and heating it under oxidizing conditions to volatilize all the excess antimony as fume.

Pebble Mill—No. 1,536,491. May 5, 1925. C. J. Gunderoth, Copperhill, Tenn. A pebble mill of a roughly elliptical cross-section, a gear and two riding rings belting the mill near its center.

Magnetic Separator—No. 1,536,541. May 5, 1925. Georg Ullich, Magdeburg, Germany, assignor to Fried. Krupp Aktiengesellschaft Grusonwerk, Magdeburg-Buckau, Germany. A process of magnetic separation consisting in conducting the material to be separated through several zones of a magnetic field of progressively increasing strength.

Petroleum Drilling

No. 1,536,348. May 5, 1925. P. H. Mack, Bradford, Pa., assignor to Oil Well Supply Co., Pittsburgh, Pa. A gas escape valve for oil wells.

No. 1,536,370. May 5, 1925. H. E. Becker, Brea, Calif., assignor to Regan Forge & Engineering Co., Inc., San Pedro, Calif. An oil-well packer.

No. 1,537,844. May 12, 1925. W. E. McDonald, Sperry, Okla. A combined pumping and pulling rig for oil wells.

No. 1,533,760. April 14, 1925. C. B. Rush, Kiefer, Okla. An oil-well barrel.

No. 1,533,976. April 14, 1925. O. F. Devolld, Bartlesville, Okla. An oil pump.

Rock Drills

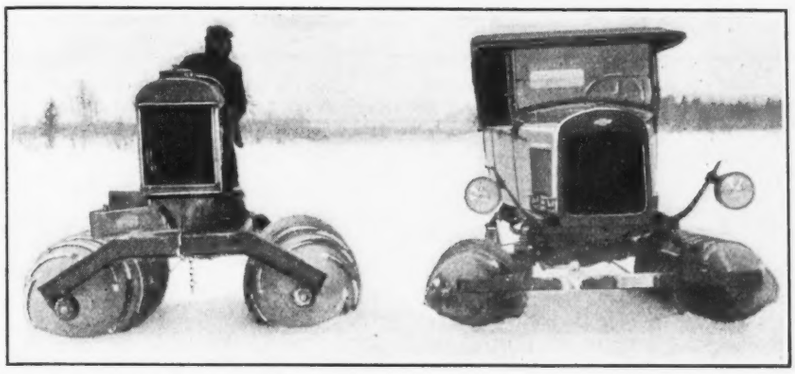
Reissue No. 16,061. May 5, 1925. F. W. Thurston, New York City. A drill rod and bit with superior wear-resisting, fatigue-resisting, and shock-absorbing qualities.

No. 1,536,600. May 5, 1925. O. B. Anderson, Marquette, Mich. An exploring drill consisting of a drill stem with an inner rotary bit and an outer rotary fishtail bit, spaced to provide a fluid passage between them.

No. 1,538,421, May 19, 1925. O. E. Clark, Denver, assignor to the Denver Rock Drill Mfg. Co., Denver. Means for continuously rotating a rock drill in either direction.

No. 1,538,646. May 19, 1925. Adolph Nelson, Hugo, Colo. A lubricating device for drills or other compressed-air machinery.

New Machinery and Inventions



Left—Fordson engine and body mounted on a snow-motor chassis. Right—Chevrolet body and engine on a snow-motor chassis

Winter Transportation With the Snow-Motor

Earlier Models Improved Upon—Any Standard Make of Automobile May Be Used With Chassis

By Felix Edgar Wormser

Two years ago the first complete description of the snow-motor ever made public appeared in the pages of the *Mining Journal-Press*.[1] Since then many changes have been made in the design of the vehicle, but the principle of operation remains the same—that is, propulsion by cigar-shaped drums with spiral runners. A glance at the illustrations will indicate the simple method of locomotion. The latest type of machine and the one that will soon be placed upon the market does away with the bobsled steering arrangement of the older machine and uses the drums themselves for steering. A differential movement of the two propelling drums, somewhat after the principle used in steering caterpillar trucks, accomplishes this action. The device is so positive that the snow-motor can turn in its own length.

Another and most important change in the design of the snow-motor has been to build it so that any standard make of automobile or Fordson tractor may be mounted upon the snow-motor chassis and be used as a driving element.

The first of the accompanying photographs shows a light passenger automobile placed upon the snow-motor chassis. It is planned to build the machine in various sizes to serve the numerous uses to which a vehicle capable of moving over snow may be put. In recent tests, a snow-motor for passenger service made a speed of 24 miles per hour over the snow equipped with a Chevrolet body and engine. Drums for the large machines to be used in heavy trucking will be larger than in the passenger type. Tests were conducted during the past winter in logging camps to determine the ruggedness and usefulness of the snow-motor. In one test in Michigan the snow-motor attached to a Fordson tractor not only made roads from logging camp to terminal but also made four trips as against one for horse-drawn sleds. Furthermore, it hauled twice the load.

Probably one of the most useful functions of the machine will be to make a road over which automobiles and other conveyances may follow. The snow-motor, with its wide tread, packs down the snow smoothly and makes a very satisfactory surface for other vehicles. Neither the softest snow drift nor the slickest ice furnishes any obstacle for the machine to surmount. It is driven just like the ordinary automobile, using the same controls.

The "father" of the snow-motor is Colonel Henry H. Armstead, a mining engineer, who first realized the possibilities of the invention, especially as related to mining operations in snowy areas. He organized a corporation to perfect the device, and, according to present plans, the snow-motor is to be built in Detroit under the direction of A. F. Knoblock, president of Snow-Motors, Inc. Colonel Armstead is vice-president, and Harold H. Emmons, who had much to do with the development of the Liberty motor in the war, is secretary-treasurer. Directors are William S. Knudsen, president of the Chevrolet Motors; Howard Coffin, vice-president of the Hudson Motor Car Co.; Senator Robert L. Owen, and Frank F. Beall, vice-president, Gray Motor Car Co. Frederick J. Haynes, president of Dodge Brothers, is also interested in the company.

The snow-motor will travel over soft unpacked snow, as seen here

[1] "Winter Haulage and the Armstead Snow-Motor," by Felix Edgar Wormser. *Engineering and Mining Journal-Press*, Sept. 15, 1923.

Driving Mine Fans With Super-synchronous Motors

The first application of super-synchronous motors to mine fan drive will be made by the Glen Alden Coal Co., of Scranton, Pa. This company is to install five General Electric motors of this type with an aggregate rating of 1,250 hp. and ranging in speed from 90 to 150 r.p.m.

The new motors will be direct connected to ventilating fans at four of the Glen Alden mines. One of the principal advantages of this application is the elimination of the magnetic clutch, which would be necessary were the ordinary type of synchronous motor used. It is also expected, through the elimination of intermediate belting, gears, etc., to effect a saving in maintenance and power, and the super-synchronous motors will, at the same time, improve the power factor of the system.

A large snow-motor hauling a load of ice through the streets of a Michigan town

The Market Report

Daily Prices of Metals

May June	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
28	13.35	54.375	55.375	8.425	8.00@8.50	7.10
29	13.35	54.50	55.50	8.425	8.00@8.50	7.075@7.10
30	.....	.....	.....	.....	.....	.....
1	13.375	54.375	55.375	8.45	8.00@8.625	7.05@7.075
2	13.375	54.00	55.00	8.45	8.00@8.50	7.025
3	13.35	53.875	54.875	8.425	8.00@8.50	6.95@7.00
Av.	13.360	54.225	55.225	8.435	8.263	7.050

*The prices correspond to the following quotations for copper delivered: May 28th and 29th, 13.60c.; 30th (holiday); June 1st and 2nd, 13.625c.; 3rd, 13.60c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

May June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
28	60⅛	61⅛	63½	254½	254¾	32 11/16	32 11/16	34⅜	33⅞
29	60¼	61⅛	63½	251⅜	251⅞	33	33	34½	34
1	...	...	...	.....	.....	.....	.....	.....	.....
2	60⅛	61⅛	63½	250½	250¾	33¼	33	34¼	33¾
3	60	61	63¼	249¾	250¼	33½	33¼	34⅛	33⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
28	4.85⅝	67⅞	31 5/16	84s 11½d	1	4.85½	68⅛	.....	.....
29	4.85⅝	68	31⅜	84s 11½d	2	4.85⅝	68⅝	31⅝	84s 11½d
30	.....	...	31⅜	.....	3	4.85½	68⅞	31 11/16	84s 11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for May, 1925

Copper:	
New York Electrolytic	13.347
London Standard	60.131
London Electrolytic	63.560
Lead:	
New York	7.985
St. Louis	7.780
London	32.283
Silver:	
New York	67.580
London	31.273
Sterling Exchange	484.960
Zinc:	
St. Louis	6.951
London	34.223
Tin:	
99 per cent	53.675
Straits	54.620
London	245.476
Quicksilver	81.360
Antimony	15.770
Platinum:	
Refined	119.850
Crude	115.000

Metal Prices Hold Steady in Quiet Market

New York, June 3, 1925—Conditions in the metal market have been much the same as was reported last week, though sales have been in somewhat smaller volumes owing to the Memorial Day holiday here on Saturday and the Whitsuntide holiday in London on Monday. Copper and lead show little variation in price; zinc and tin are slightly lower owing to a decline abroad; and silver advanced a cent during the week.

Copper Unchanged in Six Weeks

The firm and steady copper market, with delivered prices varying from 13½ to 13⅝c., has now continued for six weeks, much to the satisfaction of both sellers and buyers, though the first-named feel that the price is too low. Domestic sales have been small again during the last week, but the export business has taken all pressure off the market. Practically all producers are selling at 13⅝c. delivered in the East, and 13¾c. in the Middle West. An occasional small lot goes at a slight concession, possibly a tenth of the total tonnage going at 13.575c. or thereabouts. Most of the business has been for comparatively early delivery, an unusual number of large consumers taking small lots for June shipment. The export market has ruled at 13.725 to 13.85c., c.i.f.

Lead Market Continues Strong

The contract price of the American Smelting & Refining Co. was advanced on May 28 from 8.25c. per lb., New York, to 8.40c.

Heavy tonnages of lead were sold during Thursday, Friday and Monday of the past week. Since then the demand has eased considerably, although one producer has found no change. As high as 8⅝c. was obtained for lead in St. Louis on Monday, but the metal was also sold for as low as 8c. by one producer, who has not advanced his price as sharply as the general market allowed. Speculative tactics in St. Louis have had much to do with the rise in the price of lead recently, but consumers are showing signs of reluctance to buy much more lead, for the time being, at present levels. June lead is available in New York at 8.40c. per lb. July metal may be procured in both the Middle West and in New York at the prices of June shipment.

Zinc Drops Under 7c.

Declines in the London market, though not important, have weakened prices here slightly so that the current level is slightly below 7c., 6.95c. having been done this morning. Domestic prices are on a par with export bids. Small tonnages have been sold each day, but there has been little life to the market for any grade. Brass Special is nominally 10 points above Prime Western and high-grade continues unchanged at 8½@8⅝c., delivered. New York quotations are 35 points above St. Louis, on Prime Western. Prompt and forward deliveries command identical prices.

Tin Market Uninteresting

Early this week some traders in the New York market began to try to depress the market on the basis of the unfavorable statistics, but prices have not shown any inclination to respond much. Straits tin has held close to 55c. during the week. Domestic consumers have not been interested in the tin market lately.

Silver Still Advancing

The advance in silver has continued and today's quotation in New York is the highest since Feb. 2. India has supported the market to some extent, but Chinese buying is chiefly responsible for the improvement in price.

Mexican Dollars—May 28th, 52½c.; 29th, 52¼c.; 30th, holiday; June 1st, 52⅜c.; 2nd, 52⅜c.; 3rd, 53c.

Foreign Exchanges Variable

Several of the European exchanges have exhibited rather wide fluctuations during the week, but the net change has not been great. Closing cable quotations on Tuesday, June 2, were: francs, 4 9925c.; lire, 4.0775c.; and marks, 23.81c. Canadian dollars, par.

Zinc and Lead Ore Higher

Joplin, Mo., May 30, 1925

Zinc Blende	Per Ton
High	$53.80
Premium, basis 60 per cent zinc	$51.00 @ $53.00
Prime Western, 60 per cent zinc	$49.00 @ $49.50
Fines and slimes	$48.00 @ $45.00
Average settling price, all.	$46.44
Lead Ore	
High	$111.10
Basis 80 per cent lead	$110.00
Average settling price, all.	$91.50

Shipments for the week: Blende, 15,546; lead, 1,729 tons. Value, all ores the week, $890,230. Shipments for five months: Blende, 335,017; calamine, 579; lead, 54,280 tons. Value, all ores five months, $23,844,870.

Buyers of zinc ore seem inclined to enlarge their purchases. Last week 17,040 tons and this week 15,700 tons are reported purchased, 32,740 in two weeks and only 37,160 the first three weeks of the month. It is reported 2,000 tons were sold for export. Sellers continue to hold firm.

Sharp demand for the limited lead output caused another advance of $5 per ton this week, $110 basis being acknowledged, while rumors of higher prices are current.

Platteville, Wis., May 30, 1925

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$50.00
Lead Ore	
Lead, basis 80 per cent lead	$110.00

Shipments for the week: Blende, 979 tons; lead, none. Shipments for the year: Blende, 19,801; lead, 807 tons. Shipments for the week to separating plants, 1,700 tons blende.

Steel Bookings Slightly Heavier

Pittsburgh, June 2, 1925

Bookings of steel orders are commonly reported to have been a trifle heavier in May than in April.

Plates have dropped $2 a ton with sharp competition for the small volume of business going, being now at $1.90@$2, Pittsburgh.

Pig Iron—A second decline of 50c. in foundry pig iron at Valley furnaces has brought a further increase in buying. Bessemer, $19.50; basic, $18.50; foundry, $18.50, f.o.b. Valley furnaces.

Connellsville Coke — Spot furnace $3; spot foundry $3.75@$4.25.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £118 long ton.

Antimony—Per lb.:
Chinese brands, nominal, 16¼@16¾c.
Cookson's "C" grade, 17¾c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½@13c.

White oxide, Chinese, 99 per cent Sb_2O_3, 16@16½c.

Bismuth — $2 per lb. in ton lots. London, 7s. 6d.

Cadmium—60c. per lb. A little again sold at 50c. London, 2s. 3d.@2s. 4d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 8s. for black oxide.

[1]Germanium Oxide—25 to 50 gm. lots, $7.50 per gm.

Iridium—$375@$400 per oz. Nominal.

[1]Lithium—95@96 per cent grade in 1 to 5 lb. lots, $75 per lb.

Magnesium—Ingot, 99.85 per cent, $1 per lb., in one-half ton lots; Ingot, 99 per cent, 95c. per lb., in one-half ton lots.
Prices not expected to change for remainder of year.
London quotes 4s. for 99 per cent ingots or sticks.

[1]Molybdenum—99 per cent, $25 per kg.

Monel Metal—32c. per lb.

Nickel—Ingot, 31c.; shot, 32c.; e[1]ectrolytic, 38c. (99.75 per cent grade). London, £170@£175 per long ton.
Market fairly active. Export inquiries have been placed recently.

Osmiridium—Crude, $58.50 per oz.

Osmium—$100@$104 per oz.

Palladium—$79@$83 per oz. Crude, $60 per oz. London, £17½.

Platinum—Refined, $120 per oz.
Crude, $115.
London, £24½ per oz. for refined.

Quicksilver—Per 75-lb. flask, $82@$83. San Francisco wires $82. Quiet. London £13.

Radium—$70 per mg. radium content.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.20 per lb.

[1]Tantalum—Metal sheets, $275 per lb.

Tellurium—$2 per lb.

[1]Thallium Metal—Ingot, 99 per cent pure, $5 per lb. in 25-lb. lots.

Tungsten Metal—Powder, 97 to 98 per cent, $1 per lb. contained tungsten.

[1]Price furnished by Foote Mineral Co., Philadelphia.

[1]Zirconium Metal—98 per cent grade, per lb., $30.

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:
Indian, $20@$22.50.
Rhodesian, $22.
New Caledonian, $24.
Market nominal.

[1]Galena Radio Crystals—Best quality (50 per cent of sized fragments good) 50c. per lb. in 500-lb. lots, f.o.b. Philadelphia.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports:
Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.
Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range, $4.55.
High phosphorus foundry, over 0.18 per cent P, $4.15.
Eastern ores, cents per unit delivered at furnaces:
Foundry and basic, 53 to 63 per cent, 8.75c.
Foreign ores, f.o.b. cars Atlantic ports, cents per unit:
Swedish and Norwegian, low phosphorus, 68 per cent, 11@11½c.
Spanish, low phosphorus, 52@54 per cent, 8@9½c.
Spanish, foundry or basic, 66@68 per cent, 9@10c.
Swedish foundry or basic, 66@68 per cent, 9@10c.

Manganese Ore—45c. per long ton unit, seaport exclusive of duty. Market nominal. Chemical grades[1], powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian, and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—65@70c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Tantalum Ore—Foreign, 75c. per lb. of Ta_2O_5 contained, c.i.f. New York.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $11.
High-grade scheelite, $11.50.
Western situation unchanged and prices are nominal for scheelite.

Vanadium — Minimum 18 per cent V_2O_5, $1@$1.25 per lb. V_2O_5. Nominal.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

[1]Amblygonite—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos:
Crude No. 1—$375@$450.
Crude No. 2—$225@$300.
Spinning fibers—$100@$200.
Magnesia and compressed sheet fibers—$65@$115.
Shingle stock—$50@$70.
Paper stock—$35@$40.
Cement stock—$15@$25.
Floats—$9@$12.
Sand—$6@$8.
All per short ton, f.o.b. mine, Quebec, tax and bags included.
No. 1 Rhodesian crude, $280; No. 2,

$200@$225 per short ton, c.i.f. New York.

With the virtual consummation of the asbestos merger prices are expected to advance. Sales have picked up since first of year.

Barytes—f.o.b. Kings Creek, S. C.:
Crude, $7@$8 per gross ton.
Ground, off color, $14 per ton.
White, bleached, $17 per ton.
Waterground, 300 mesh, bags included, $22 per ton, Charlotte, N. C.
Crude, $8, f.o.b. Ga.
Crude, $8.50, f.o.b. Mo.
Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.
In Canada, 94@96 per cent $BaSO_4$, $9 per net ton, f.o.b. mine.
Demand remains steady. Average consumption of barytes looked for.

Bauxite — American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.50.
Pulverized and dried, $14.
Calcined, crushed, $19@$20.
Foreign, per metric ton, c.i.f.:
French red, 5 per cent SiO_2, $5@$7.
Adriatic, low SiO_2, $4@$6.50.

Beryl—$65@$80 per ton, hand-sorted crystals, in ton lots f.o.b. Vermont. Nominal.

Borax—Granulated or powdered, in bags, 4¾c. per lb., delivered. Crystals, 5c. Market normal.

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $40 per ton in carload lots.

Chalk—F.o.b. New York, per lb.:
English, extra light, 5c.
Domestic, light, 4½@4¾c.
Domestic, heavy, 3½@3¾c.
In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:
Crude No. 1, $7.
Crude No. 2, $5.50.
Washed, $8.
Powdered, $10@$20.
Powdered (Blue Ridge), $10@$14.
Imported English, f.o.b. American ports:
Lump, $12@$20.
Powdered, $45@$50.
1A grades, domestic, $16@$18, f.o.b. mines. Market slow.

Corundum — South African, $65 per ton, New York.

Diatomaceous Earth—Per short ton, f.o.b. plant, California:
Kiln-fired brick, $65.
Kiln-fired aggregate, ¼ in., $45.
Insulating powder, $30.
Natural aggregate, ¼ in., $20.
Air-floated powder, $40.
In *New England*, per ton:
Pulverized, $65.
Air float, $75.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 3½c.
Market remains good.

Feldspar—Per long ton, f.o.b. cars, *North Carolina:*
No. 1 pottery grade, $5.50@$6.50, depending upon quality.
No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $6.75@$7.25.
In *Connecticut*, per net ton, f.o.b. mines:
40 to 200 mesh, $16@$30.
In *New Hampshire*, per net ton, f.o.b. mines:
No. 1, not over 10 per cent SiO_2, $7.75.
No. 2 pottery grade, $7.
Ground, $17@$20, f.o.b. mill.
Market fair.
In *New York*, per ton, f.o.b. cars:
No. 1 crude, $8.
Market good.
In *Maine:*
No. 1, ground, $19.
In *Tennessee:*
Pottery grades, $16@$21, according to analysis and mesh.
Tile grades, $14@$16.
Enameling grades, $11@$16.
Crude, $7 for ordinary grades. As high as $7.25 offered for exceptional quality.
Market improving.
In *Virginia:*
No. 1 Porcelain, 140 mesh, $23.
Enamelers' grades, 120 mesh, $22.
Glassmakers', 30-100 mesh, $19.
In *Maryland:*
No. 1 body spar, 120 mesh, $17.
Enamelers' grade, 80-100 mesh, $15.
Glassmakers' grade, 30-100 mesh, $13@$15.
Market quiet but good.
In *Canada*, f.o.b. mine:
Crude, No. 1, over 12½ per cent potash, less than 5 per cent SiO_2, $7.25 @$7.50 per net ton.
Crude, No. 2, 20 to 25 per cent SiO_2, $5@$5.50 per net ton.
Ground, No. 1, 180 mesh, $20 per net ton, bags included.
Ground, No. 2, 180 mesh, $15 per net ton, bags included.

Fluorspar — F.o.b. Middle Western mines, per net ton:
Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $16@$19.
Lump, No. 1, 95@98 per cent CaF_2, not over 2½ per cent SiO_2, $30.
Lump, No. 2, not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $19.
Ground, 95 to 98 per cent CaF_2 and not over 2½ per cent SiO_2, $30@$32.50 in bulk, $37 in bags or barrels.
Acid lump, 98 per cent CaF_2, not over 1 per cent SiO_2, $35@$36.
Acid, ground, not less than 98 per cent CaF_2 and not over 1 per cent SiO_2, $45 in bulk, $50 in packages.
Market poor.
In Canada, 84@86 per cent CaF_2, less than 5 per cent silica, $18 per net ton, f.o.b. mine.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.
Powdered, imported, duty paid, $23 @$25 per ton.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Canadian, $70@$80, f.o.b. mines.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Gilsonite—Per ton, f.o.b. Colorado:
Jet asphaltum, $36.
Selects, $33.
Seconds (ordinary grades), $25.50
Prices strong. Demand fair.
Peerless black, $32.90.
Market steady.

Graphite—First quality, per lb.:
Ceylon lump, 8½@9c.
Ceylon chip, 6½@7c.
Ceylon dust, 3½@5c.
Crude amorphous, $15@$35 per ton.
Flake, No. 1 and No. 2 from New York, 12@30c.
Manufactured grades:
Flake, 12@30c. per lb.
Extra fine ground, 12@30c.
Medium fine ground, 5@14c.
Facings, 5@8c.
Amorphous, 5@18c. per lb.
Prices much higher than a year ago. Madagascar graphite scarce and very high priced. Other grades much higher in sympathy. Feeling prevalent that graphite will remain higher priced for some time to come.

Gypsum—Per ton, depending upon source:
Crushed rock, $2.75@$3.
Ground, $4@$6.
Agricultural, $6@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $60 per short ton, Florida mines.

Iron Oxide (See Ocher) — Ground, 95 per cent through 200 mesh, Standard Spanish red, $40 per ton.

Kaolin—See China Clay.

Lepidolite—$20@$30 per ton for ordinary grades. Nominal.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $42.50.
Dead burned, $29@$31, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.
Market very good. Its future depends upon foreign competition.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 6c. per lb.
Grade "AC," 7c. per lb.
Grade "AA," fine, 8c. per lb.
Grade "C," fine and lump, 9c.
Grade "C," lump, 12c.

Mica—
North Carolina prices:
Scrap, $20 per net ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1¼ in., 7c.

1½ x 2 in.,	18c.	3 x 4 in.,	$2.40.
2 x 2 in.,	50c.	3 x 5 in.,	$2.75.
2 x 3 in.,	$1.00.	4 x 6 in.,	$3.50.
3 x 3 in.,	$2.00.	6 x 8 in.,	$6.00

No. 2 quality per lb.:

1½ x 2 in.,	15c.	3 x 4 in.,	$1.30.
2 x 2 in.,	30c.	3 x 5 in.,	$1.80.
2 x 3 in.,	60c.	4 x 6 in.,	$2.40.
3 x 3 in.,	$1.00.	Punch	6c.

Market very good. Prices strong. Demand for scrap improved.
Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.

Ground, 140 mesh, $125.
Dry ground, roofing, $30.
Dry ground, 80 mesh, $35.
Dry ground, 100 mesh, $67.50.
Dry ground, 160 mesh, $70.00.
Roofing grade, 20 mesh, $35.
Roofing grade, 100 mesh, $70.
Market good.

In *New Hampshire:*
Washer and disk, $320 per ton.
Scrap, $24 per ton.

White, dry ground, f.o.b. New England mill:
20 mesh, $30 per ton.
40 mesh, $50.
60 mesh, $65.
100 mesh, $80.
200 mesh, $90.

Madagascar, amber, dark, free from iron, per lb., f.o.b. New York:

No. 1	$1.80	No. 4	$0.50
No. 2	1.30	No. 5	.20
No. 3	.85	No. 6	.15

Larger demand reported for all sizes of mica and prices are firmer. Scrap mica is especially strong in the South.

[1]**Monazite**—Minimum 6 per cent ThO_2, $120 per ton.

Ocher—"Yellow Peruvian," $25@$30 per ton, Georgia mines. Market good.

Ozocerite—Per lb. in bags, New York:
Black, 160 deg. melting point, 24@25c.
Green, 170 deg. melting point, 26@30c.

Phosphate — Per long ton, f.o.b., *Florida* export prices:
76@77 per cent, pebble, $5.75.
75 per cent, $5.25.
74@75 per cent, $5.
70 per cent, $3.50.
68 per cent, $3.25.
Market firm.

In *Tennessee*, per long ton:
78 per cent lump, $8.
75 per cent hand-mined lump, $6.75@$7.
75 per cent washed lump, $7.
72 per cent washed run of mine, $5@$5.50.
65 per cent ground 95 per cent through 100 mesh, $7 per short ton.

Potash—	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent	$34.55	$33.30
Sulphate of potash 90@95 per cent, basis 90 per cent	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent	19.03	17.80
Manure salt 20 per cent	12.55	11.00
Kainit 14 per cent	10.25	8.25
Kainit 12.4 per cent	9.75	7.75

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

For prompt shipment:
5 per cent on minimum quantity of 50 short tons K_2O
6 per cent on minimum quantity of 100 short tons K_2O
7 per cent on minimum quantity of 300 short tons K_2O
10 per cent on minimum quantity of 500 short tons K_2O

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 13c. per unit of sulphur.
Run of mine, 12c. per unit of sulphur.
Cinder from ore to remain property of buyers.

Market firmer. Many inquiries on account of the rumored rise in price of sulphur.

Quartz Rock Crystals — Colorless, clear and flawed, pieces ½ to 1 lb. in weight, 30c. per lb. in ton lots.
For optical purposes, double above prices.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, $200 per ton, Florida.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
400 mesh, $31.
325 mesh, $26.
250 mesh, $22.
200 mesh, $20.
100 mesh, $8.
Other grades per ton:
140 mesh, $6.25.
200 mesh, $8.75.
Packed in bags, f.o.b. Ottawa, Ill.

Quartzite, in Canada, 99 per cent SiO_2, $3 net ton.

Glass sand, $2@$2.25 per ton; brick and molding sand, $2@$2.25. Dull.

Spodumene — $20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s New York.

Talc—Per ton, in 50-lb. paper bags, *Vermont* mills, carloads:
Ground. 200 mesh, extra white, $11@$12, bags extra.
Ground, 180 mesh, medium white, $10.50@$11.50, bags extra.
Ground, 160 mesh, medium white, $10@$11.
If packed in burlap bags, $1 per ton less plus 15c. each for bags.
Prices firm. Some abatement in demand between middle of March and middle of April, but marked improvement since.

In *New York*, double air-floated, including containers, per net ton:
200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand good.

In *California*, $20@$30 per ton, ground.

In *Georgia*, powdered, per ton:
Gray or yellow, $8@$10.
Red or white, $10@$14.
Market good for powders.
White, $12@$15.
Grayish white, $8@$10.
Red, $10@$15.
Yellow, $8@$10.
Roofing, $8@$10.
Market good.

Tripoli—Per short ton, burlap bags paper liners, per minimum carload 36 tons, f.o.b. Missouri:
Once ground through 40 mesh:
Rose and cream colored, $20.
White, $18@$27.
Double ground through 110 mesh:
Rose and cream, $17@$25.
White, $19@$30.
Air-float through 200 mesh:
Rose and cream, $35@$40.
White, $40.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Entering seasonal slow summer period.

Zircon—Freight allowed east of Mississippi River:
99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

Mineral Products

Arsenious Oxide (white arsenic)—5c. per lb. delivered. Quiet.

Copper Sulphate—4.65c. per lb.

Sodium Nitrate — $2.67 per 100 lb., ex vessel Atlantic ports.

Sodium Sulphate—$19@$22 per ton, New York.

Zinc Oxide—Per lb. in bags:
Lead free, 7¾c.
5 per cent lead sulphate, 6¾c.
10 to 35 per cent lead sulphate, 6½c.
French, red seal, 9¾c.
French, green seal, 10¾c.
French, white seal, 12c.

Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

Ferrochrome — 0.1 per cent carbon, 35c. per lb. of contained chromium; 2 per cent carbon, 23c. per lb.; 4 to 6 per cent carbon, 11½c. per lb.

Ferromanganese—Domestic and foreign, 78@82 per cent, $115 per gross ton. Spiegeleisen, 19@21 per cent, $33 f.o.b. furnace; 16@19 per cent, $32.

Ferromolybdenum—$1.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $35.50@$39.50 per gross ton, f.o.b. works; 50 per cent, $85 delivered, 75 per cent, $155.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — $1 per lb. of contained W, f.o.b. works. Nominal.

[1]**Ferro-uranium**—30 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium—Per lb. of V contained f.o.b. works:
Open hearth, $3.25@$3.50.
Crucible, $3.50@$3.65.
Primos, $3.65@$4.
All ferro-alloys active.

Metal Products

Rolled Copper—Sheets, 21¾c.; wire, 15¾c.

Lead Sheets—Full lead sheets, 12½c. per lb.; cut lead sheets, 12½c. in quantity, mill lots.

Nickel Silver—28c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 19¾c. per lb.; rods, 16¾c. per lb.

Zinc Sheets—10c. per lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$48@$50 per net ton, f.o.b. shipping point.

Firebrick—First quality, $43@$46 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $36@$40.

Magnesite — Brick, 9-in. straights, $65@$68 per net ton, f.o.b. works.

Silica Brick—$40@$42 per M. Pennsylvania; $45@$47 Alabama; $49@$51, Indiana.

[1]**Zirkite**—Powdered, 80 per cent ZrO_2, 3c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 80c.@$1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1924	1925	1924	1925	1924	1925
January	63.447	68.447	33.549	32.197	425.524	477.702
February	64.359	68.472	33.565	32.245	430.457	476.886
March	63.957	67.808	33.483	31.935	428.769	477.279
April	64.139	66.899	33.065	31.372	434.788	479.034
May	65.524	67.580	33.870	31.276	435.716	484.960
June	66.690	.....	34.758	.....	431.675	.....
July	67.159	.....	34.509	.....	436.649	.....
August	68.519	.....	34.213	.....	449.510	.....
September	69.350	.....	34.832	.....	445.740	.....
October	70.827	.....	35.387	.....	448.274	.....
November	69.299	.....	33.775	.....	460.543	.....
December	68.096	.....	32.620	.....	469.115	.....
Year	66.781	.....	33.969	.....	441.397	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1924	1925	1924	1925	1924	1925
January	12.401	14.709	61.273	66.065	67.193	70.607
February	12.708	14.463	63.113	64.713	68.167	69.525
March	13.515	14.004	66.137	62.892	72.087	67.739
April	13.206	13.252	64.338	60.575	70.150	64.194
May	12.772	13.347	62.006	60.131	67.648	63.560
June	12.327	.....	61.375	.....	66.313	.....
July	12.390	.....	61.652	.....	65.815	.....
August	13.221	.....	63.481	.....	67.800	.....
September	12.917	.....	62.750	.....	67.125	.....
October	12.933	.....	62.641	.....	66.620	.....
November	13.635	.....	63.731	.....	68.063	.....
December	14.260	.....	65.295	.....	69.762	.....
Year	13.024	.....	63.149	.....	68.062	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1924	1925	1924	1925	1924	1925
January	7.972	10.169	8.002	9.953	31.528	41.443
February	8.554	9.428	8.643	9.126	34.589	37.944
March	9.013	8.914	8.891	8.578	37.161	36.804
April	8.263	8.005	7.932	7.662	32.819	32.791
May	7.269	7.985	6.973	7.780	29.426	32.283
June	7.020	.....	6.848	.....	32.138	.....
July	7.117	.....	6.886	.....	32.916	.....
August	7.827	.....	7.764	.....	32.728	.....
September	8.00	.....	7.876	.....	33.023	.....
October	8.235	.....	8.118	.....	35.715	.....
November	8.689	.....	8.590	.....	39.425	.....
December	9.207	.....	9.106	.....	41.583	.....
	8.097	.....	7.969	.....	34.421	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1924	1925	1924	1925	1924	1925
January	48.250	57.692	48.750	58.250	246.790	265.560
February	52.772	56.517	53.272	57.068	272.399	262.181
March	54.370	53.038	54.870	53.733	277.429	245.682
April	49.457	51.380	49.957	52.135	250.863	237.006
May	43.611	53.675	44.111	54.620	218.511	245.476
June	42.265	.....	42.765	.....	219.219	.....
July	45.750	.....	46.250	.....	233.332	.....
August	51.409	.....	51.909	.....	254.638	.....
September	48.595	.....	49.095	.....	243.511	.....
October	50.038	.....	50.538	.....	248.543	.....
November	53.848	.....	54.348	.....	257.738	.....
December	55.721	.....	56.245	.....	261.875	.....
Year	49.674	.....	50.176	.....	248.737	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1924	1925	1924	1925
January	6.426	7.738	34.761	37.917
February	6.756	7.480	36.518	36.528
March	6.488	7.319	35.298	35.741
April	6.121	6.985	32.588	34.644
May	5.793	6.951	30.648	34.223
June	5.792	.....	31.788	.....
July	5.898	.....	32.193	.....
August	6.175	.....	32.544	.....
September	6.181	.....	32.926	.....
October	6.324	.....	33.514	.....
November	6.796	.....	35.022	.....
December	7.374	.....	36.932	.....
Year	6.344	.....	33.728	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York
	1924	1925	1924	1925	1924	1925	1925
January	10.279	17.428	59.500	81.595	122.115	117.000	111.663
February	10.935	19.795	59.565	79.386	124.739	117.000	114.216
March	11.442	15.553	64.269	80.481	121.692	117.000	115.000
April	9.952	12.553	74.308	82.327	115.577	118.269	114.769
May	8.755	15.770	76.962	81.360	115.731	119.850	115.000
June	8.403	.....	73.720	.....	116.000	.....	.....
July	8.477	.....	72.173	.....	118.231	.....	.....
August	9.839	.....	72.096	.....	120.000	.....	.....
September	11.022	.....	72.423	.....	118.923	.....	.....
October	11.519	.....	70.654	.....	118.000	.....	.....
November	14.385	.....	68.708	.....	117.792	.....	.....
December	15.024	.....	72.750	.....	117.000	.....	.....
Year	10.836	.....	69.761	.....	118.817	.....	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1924	1925	1924	1925	1924	1925
January	24.76	24.66	23.76	23.76	23.88	23.76
February	25.26	24.50	23.76	23.26	25.06	23.76
March	25.14	24.06	23.76	23.06	24.76	22.91
April	24.56	21.57	23.26	20.26	23.80	21.16
May	23.89	.....	22.08	.....	22.91	.....
June	22.90	.....	21.49	.....	21.48	.....
July	21.90	.....	20.76	.....	20.76	.....
August	21.76	.....	20.76	.....	20.99	.....
September	21.76	.....	20.76	.....	21.68	.....
October	21.76	.....	20.26	.....	21.26	.....
November	22.08	.....	21.44	.....	21.17	.....
December	23.65	.....	22.04	.....	22.86	.....
Year	23.28	.....	22.01	.....	22.55	.....

In dollars per long ton.

Monthly Crude Copper Production

Domestic

	1925			
	January	February	March	April
Alaska shipments	2,565,375	6,855,097	11,177,011	7,329,681
Calumet & Arizona	3,788,000	3,068,000	3,416,000	5,196,000
Miami	4,800,000	4,317,009	4,428,000	4,388,000
New Cornelia	6,906,512	6,063,428	6,489,000	6,335,821
Old Dominion	2,921,000	3,377,000	3,152,000	2,550,000
Phelps Dodge	13,444,000	13,036,000	13,786,000	13,797,000
United Verde Extension	3,739,542	3,631,638	3,368,904	3,810,358
A.S. & R. & Tenn. Copper	16,700,000	12,500,000	15,500,000	14,700,000
Imports: Ore and concentrates, matte	11,229,750	16,662,339	8,496,693	18,022,747
Partly from				
Chile	1,309,814	3,463,647	1,497,403	6,289,233
Cuba	.....	2,625,886	.....	8,379,977
Canada	4,942,710	5,016,488	4,341,377	559,123
Mexico	3,519,950	2,255,980	2,235,000	1,962,210
Imports of black and blister, unrefined	15,858,870	35,002,977	27,513,110	40,255,461
Partly from				
Chile	3,934,732	6,518,562	5,602,705	12,982,578
Peru	3,282,903	6,261,118	2,431,252	1,473,674
Africa	.....	2,464,764	9,492,731	17,612,136
Mexico	3,681,048	8,772,922	5,962,311	5,835,128
Imports of refined and old	5,652,229	8,561,246	9,044,000	8,508,750

Foreign

Boleo, Mexico	1,530,270	1,389,150	1,551,769	110,250
Falcon Mines, Rhodesia	420,000	.....	438,000	.....
Furukawa, Japan	2,476,376	2,703,682	2,930,286	.....
Cons. M & S., Canada	.....	.....	.....	.....
Granby Cons., Canada	3,282,570	2,761,468	2,938,903	3,316,290
Katanga, Africa	15,866,025	12,857,510	15,922,305	15,435,000
Mount Morgan, Aust.	298,000	202,000	544,000	.....
Mount Lyell, Aust.	800,000	800,000	800,000	.....
Phelps Dodge, Mexican	3,134,000	3,518,000	3,983,000	3,283,000
Sumitomo, Japan	2,136,864	2,124,442	1,888,021	2,445,236

Comparative U. S. Copper Mine Production

	1922	1923	1924	1925
January	32,010,292	112,267,000	133,356,000	148,716,000
February	45,957,530	102,725,000	128,260,000	137,578,000
March	55,705,760	121,562,000	129,816,000	149,802,000
April	76,601,000	118,157,000	131,928,000	149,864,000
May	88,714,000	125,438,000	130,644,000	.....
June	93,740,000	125,479,000	127,506,000	.....
July	91,000,000	125,249,000	129,574,000	.....
August	101,188,000	131,088,000	133,512,000	.....
September	96,408,000	124,523,000	126,346,000	.....
October	103,273,000	132,481,000	137,924,000	.....
November	102,845,000	127,963,000	136,582,000	.....
December	103,003,000	129,354,000	135,294,000	.....

Company Reports

Greene Cananea Copper Co.

The Cananea Consolidated Copper Co., S. A., produced during the year: 29,664,441 lb. of copper, 501,489.37 oz. of silver, and 3,400.406 oz. of gold. Cost of refined copper for the year 1924, including depreciation and all charges except depletion, was 13.0538c. per lb. The price received for refined copper was 13.1023c. per lb. This was 1.31c. per lb. less than the price received the previous year, although world consumption for the year was in excess of production.

The most important achievement of the year was the successful application of selective flotation to the concentrating ores, with the resulting beneficial effect on the other operations of the entire reduction division.

The practice of leaching the copper from the fillings in the old stopes by percolating acid water solutions through them and precipitating the dissolved copper on scrap iron is being gradually extended and will result in a continued increased production of cheap copper from this source.

Combined Balance Sheet, Dec. 31, 1924

Assets		
Mines and mining claims, lands, railways, buildings and equipment, less reserve for depreciation	$51,710,961.54	
Investments in sundry companies	80,886.31	$51,791,847.85
Current assets		2,383,884.65
		$54,175,732.50
Liabilities		
Capital Stock:		
Issued—500,000 shares		$50,000,000.00
Mexican Legal Reserve		4,000.00
Current liabilities		301,892.77
Surplus:		
Balance Dec. 31, 1923	$3,813,717.77	
Net income—year ending Dec. 31, 1924	56,121.96	3,869,839.72
		$54,175,732.50

Combined Income Account

Income:	
Sales of metals	$5,172,677.01
Miscellaneous receipts	147,245.03
	$5,319,922.04
Expense	4,828,461.49
	$491,460.55
Depreciation and replacements of buildings and equipment	409,523.28
	$81,937.27
Interest paid	46,489.64
	$35,447.63
Income from investments	20,674.33
Balance—Net income carried to balance sheet	$56,121.96

Consolidated Coppermines Corporation

Copper; Kimberley, Nev.

Production of Consolidated Coppermines for 1924 was 2,830,715 lb. of copper, 109.7 oz. of gold, 7,005 oz. of silver, 54,566 lb. of lead, and 20,059 lb. of zinc, from 24,930 tons of ore. During the latter part of the year, leaching-in-place operations were started on the Brooks mine. The average circulation approximated 230 gal. per minute, carrying 7.14 lb. of copper per 1,000 gal., and the plant recovery was 86.73 per cent. The result indicates that certain areas in the district will be amenable to leaching, though others do not lend themselves so readily. The work to be done on dumps, together with leaching in place, should furnish interesting information during the ensuing year.

Assets and Liabilities, Dec. 31, 1924

Assets	
Property and equipment	$6,718,908.06
Deferred development	3,520,310.20
Investments	149,295.62
Treasury stock	35,166.67
Deferred accounts	3,179.56
Current assets	474,781.69
	$10,901,641.80
Liabilities	
Capital stock outstanding	$6,152,752.13
Vendors (stock to be issued for property acquired)	229,793.49
Current liabilities	94,645.16
Deferred liabilities	9,733.34
Reserve for depletion	354,663.25
Paid-in surplus	4,060,054.43
	$10,901,641.80

Imports and Exports of Ores and Metals in April, 1924 and 1925

Imports

In Pounds Unless Otherwise Stated

	April, 1924	April, 1925
Antimony		
Ores	.....	286,812
Liquated, regulus, or metal	2,718,539	2,103,880
Copper		
Ores	5,348,828	7,277,504
Concentrates	6,195,810	10,713,426
Regulus, coarse metal and cement	33,161	131,817
Imported from:		
Spain	456,887	593,376
Canada	2,969,892	559,123
Mexico	2,362,198	1,962,210
Cuba	4,040,000	8,379,977
Chile	1,650,190	6,289,233
Colombia	10,466	.....
Peru	27,901	16,393
Other countries	60,265	322,435
Unrefined, black, blister, converted copper in pigs, bars, etc	31,688,505	40,255,461
Imported from:		
Canada	5,528,287	2,351,945
Mexico	7,082,030	5,835,128
Chile	7,013,143	12,982,578
Peru	2,428,445	1,473,674
Portuguese Africa	9,630,942	17,612,136
Other countries	5,658	.....
Refined copper	10,068,760	7,809,898
Old and clippings for remanufacture	221,806	688,082
Composition metal, copper chief value	20,752	112
Copper manufactures	7,122	10,658
Brass		
Old and clippings for remanufacture	1,012,369	521,878
Manufactures of brass	58,123	81,916
Lead		
Ore and matte	3,722,825	7,659,057
Bullion or base bullion	17,910,771	15,263,802
Pigs, bars, other forms, and old	5,195,063	102,429
Manufactures of, except type metal	27,637	15,472
Manganese ore, long tons	29,729	15,189
Pyrites, long tons	13,746	20,479
Tin		
Tin ore, tons	21	13
In blocks, bars, and pigs	22,806,793	10,430,188
Imported from		
United Kingdom	2,236,681	2,677,233
Br. Str. Settlements	18,185,967	6,589,176
China	56,113	.....
Dutch E. Indies	675,595	23,385
Hongkong	1,001,617	620,916
Australia	89,690	93,600
Other countries	561,130	425,878
Zinc		
Ore, free	.....	.....
dutiable	.....	5,880,155
Blocks, pigs, and other forms	8,202	.....
Zinc dust	4,074	12,082

Exports of Copper, Lead and Zinc

In Pounds

	April, 1924	April, 1925
Copper		
Ores, concentrates, matte, and regulus	32,543	.....
Copper and manufactures of	99,760,093	108,143,872
Refined in ingots, bars, and other forms	91,265,411	97,621,613
Exported to		
Belgium	9,243,118	8,096,364
France	17,220,055	15,138,619
Germany	24,606,051	22,421,857
Italy	10,453,984	9,137,072
Netherlands	6,336,714	13,120,799
Spain	632,470	325,011
Sweden	3,530,920	2,636,958
United Kingdom	11,268,240	20,842,932
Canada	1,452,749	1,339,358
British India	150,741	.....
China	1,388,800	2,620,800
Japan	3,461,105	223,789
Other countries	1,565,464	1,718,054
Old and scrap copper	707,335	675,659
Pipes and tubes	140,355	202,804
Plates and sheets	623,381	1,248,655
Rods	5,049,703	5,666,839
Wire	869,828	821,835
Insulated copper wire and cable	917,306	1,655,855
Other manufactures of copper	186,774	250,612
Lead		
Pigs, bars, and other forms		
From domestic ore	50,904	695,224
From foreign ore	5,209,661	30,030,607
Exported to		
France	2,016,132	1,053,169
Germany	840,253	6,132,945
Netherlands	224,025	1,162,436
United Kingdom	784,316	19,378,986
Other Europe	560,875	672,338
Argentina	112,000	629,585
Brazil	448,060	338,475
Other countries	274,904	1,357,897
Zinc		
Dross	.....	2,363,809
Ores and concentrates	559	.....
Zinc (spelter) in slabs, blocks, or pigs	9,380,398	10,604,825
Exported to		
Belgium	112,022	560,030
France	1,460,982	1,943,355
Italy	336,023	1,568,495
Germany	1,064,129	1,338,156
United Kingdom	6,120,730	3,773,477
Canada	38,501	111,292
Other countries	248,011	1,310,020
In sheets, strips, and other forms	697,733	597,037
Zinc dust	498,209	447,144
Other zinc manufactures	125,047	56,674

Mining Stocks—Week Ended June 6, 1925

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Anaconda	New York	40¼	38¼	40	Ap.16, My.23, 0.75
Arcadian Consol.	Boston	1 5/16	1¼	1¼	
Ariz. Com'l	Boston	10¼	10¼	10¼	Ja.19, Ja 31 SA 0.50
Calaveras	N. Y. Curb			1¼	
Calumet & Arizona	New York	50¾	48¼	49	Jn.15, Jn.22 Q 0.50
Calumet & Hecla	Boston	13	12¼	13	Ja.30, Mh.4 0.50
Canario Copper	N. Y. Curb	6	5¾	6	
Cerro de Pasco	New York	51¼	49½	51¼	Ap.23 My.1, Q 1.00
Chile Copper	New York	35¼	33¾	34¾	Jn.3, Jn.29, Q 0.62½
Chino	New York	21¾	20¼	21¼	Sept., 1920 0.37½
Con. Coppermines	N. Y. Curb	2 1/16	2	2	
Copper Range	Boston	20¾	20¼	20¼	Ap.9, My.4 1.00
Crystal Copper	Boston Curb	*59	*54	*55	
East Butte	Boston	3¼	3¼	3¼	Dec., 1919 0.50
First National	Boston Curb	*28	*22	*26	Feb., 1919 0.15
Franklin	Boston	*50	*50	*50	
Granby Consol	New York	16	14¼	16	May, 1919 1.25
Greene-Cananea	New York	13¾	13¼	13¾	Nov., 1920 0.50
Hancock	Boston			*75	
HoweSound,new,r. t.c.	N. Y. Curb	17¼	16¼	16¼	April, 1924 0.05
Inspiration Consl.	New York	27	22¾	27	Jn.18, Jy.6, Q 0.50
Iron Cap	Boston Curb	1¼	1 7/16	1¼	May, 1923 0.15
Isle Royale	Boston	12¾	11	12¾	Sept., 1923 0.50
Jerome Verde Dev	N. Y. Curb	1¼	1¼	1¼	
Kennecott	New York	51¼	50¼	51	Jn.5, Jy.1, Q 0.75
Lake Copper	Boston	1¼	1	1¼	Jn.1, Jn 15 Q 0.50
Magma Copper	NewYork	42¾	41¼	42¼	Jn. 15, Jy. 15, 0.75
Mason Valley	N. Y. Curb	1¾	1¾	1¾	
Mass Consolidated	Boston	*41	*41	*41	Nov., 1917 1.00
Miami Copper	New York	9¾	9¼	9¾	My.1 My.15 Q 0.25
Mohawk	Boston	28¾	27¼	28¾	My. 2, Jn. 2 1.00
Mother Lode Con.	New York	7¼	7	7¼	Jn. 12, Jn. 30 0.37½
Nevada Consol.	New York	13¼	12¼	12¾	Sept., 1920 0.25
New Cornelia	Boston	19¼	19	19¼	My. 8. My. 25Q 0.25
North Butte	Boston	1¼	1	1	Oct., 1918 0.25
Ohio Copper	N. Y. Curb	*91	*85	*88	No.14, De.2 0.05
Old Dominion	Boston	18¼	18¼	18¼	Dec., 1918 1.00
Phelps Dodge	Open Mar.	†105	100		Mh 20, Ap.2 Q 1.00
Quincy	Boston	23	21	23	Mar., 1920 1.00
Ray Consolidated	New York	13	12¼	13	Dec., 1920 0.25
Ray Hercules	N. Y. Curb			14	
St. Mary's Min. Ld.	Boston	32¼	30¼	32¼	Ap. 20, My.20, 3.00
Seneca Copper	New York			¼	
Shannon	Boston	*70	*55	*70	Nov., 1917 0.25
Shattuck Arizona	New York	6	6	6	Jan., 1920 0.25
Superior & Boston	Boston	1¼	1 1/16	1¼	
Tenn. C & C	New York	11	10¾	10¾	De.31, Ja.15,Q 0.25
United Verde Ex	N. Y. Curb	25	24¼	25	Ap. 3, My. 1 0.50
Utah Copper	New York	90¾	88¼	90¾	Mh.20,Mh.31,Q1.00
Utah Metal & T	Boston	*59	*51	*52	Dec., 1917 0.30
Victoria	Boston			*40	
Walker Mining	Salt Lake	2.50	2.50	2.50	
NICKEL-COPPER					
Internat. Nickel	New York	29¼	27¼	29¼	March, 1919 0.50
Internat. Nickel pfd.	New York	97¼	97¼	97¼	Ap.16, My.1, Q 1.50
LEAD					
Carnegie Lead & Zinc	Pittsburgh	5¼	5¼	5¼	
Gladstone M. M. Co.	Spokane	*28¼	*25	*26	Ap. 1925 0 00½
National Lead	New York	151	148	151	Jn.12, Jn.30, Q 2.00
National Lead pfd.	New York	116¼	116	116¼	My.22, Jn.15 Q 1.75
St. Joseph Lead	New York	52¼	50¼	51	Mh. 5, Mh. 20 0.50
ZINC					
Am. Z. L. & S	New York	7¾	7¼	7	May, 1920 1.00
Am. Z. L. & S. pfd.	New York	29	27¾	28¼	Nov., 1920 1.50
Butte C. & Z	New York	5¾	5¼	5¼	De.10, De.24 0.50
Butte & Superior	New York	10¼	9¾	10¼	Mh.19, Mh.31 0.50
Callahan Zn-Ld	New York	3	2¾	3	Dec., 1920 0.50
New Jersey Zn	N. Y. Curb	188¾	184¼	188¼	Jn.20,Jy. 10 Ex. 2.00
United Zinc	N. Y. Curb			*35	
Yellow Pine	Los Angeles	*72¼	*69	*70½	De.10,De.15 Q 0.04
GOLD					
Alaska Juneau	New York	1¾	1¾	1¾	
Argonaut	Toronto	*26¼	*24¼	*26	
Barry-Hollinger	Toronto	*43¼	*39¼	*39¾	
Carson Hill	Boston	*25	*25	*25	
Consol. W. Dome L.	Toronto	*13¼	*12¼	*13	
Cresson Consol. G.	N. Y. Curb	3¾	3¾	3¾	Mh.31, Ap.10 Q 0.10
Crown Reserve	Toronto	*28	*26	*26¼	Jan. 1917 0 05
Dome Mines	New York	15	13¾	14¼	Mh.31,Ap.20,Q 0.50
Golden Cycle	Colo. Springs	1.45	1.42	1.44	Dec.11, 1924 0.03
Hollinger Consol.	Toronto	14.85	14.70	14.80	Jn. 1, Jn. 17. 0.08
Homestake Mining	New York	45	44	44	My.2, My.20 M0.50
Jib. Consol	N.Y. Curb			*7	
Kirkland Lake	Toronto	*39¼	*38¼	*39	
Lake Shore	Toronto	5.88	5.73	5.80	Mh.2, Mh.16, 0 05
McIntyre-Porcupine	New York	17¼	17¼	17¼	My.1, Jn.1, 0.25
Newray	Toronto	*18	*13	*17	
Night Hawk Pen	Toronto	*23	*22	*22	
Portland	Colo. Springs	*40	*40	*40	Oct., 1920 0.01
Rand Mines	New York	37	37	37	Fe.17, Fe.25 1.79
Teck-Hughes	Toronto	1.32	1.28	1.30	
Tom Reed	Los Angeles	*45	*40	*42	Dec., 1919 0.02
Tough-Oakes	Toronto	*27½	*25	*27½	
United Eastern	N. Y. Curb	*50	*50	*50	July, 1924 0.05
Vipond Cons	Toronto	1.08	1.02	1.07	
Wright-Hargreaves	Toronto	4.35	4.30	4.30	Mh.16,Ap.1,QX0.05
GOLD AND SILVER					
Black Oak	N. Y. Curb			*81	
Con. Cortez	N. Y. Curb	*10	*9	*9	
Con. Virginia	San Francisco	5¾	6	6	
Continental Mines	N. Y. Curb			1¼	
Dolores Esperanza	N. Y. Curb	*55	*50	*50	July, 1923 0.05
Premier Gold	N. Y. Curb	2 1/16	2 1/16	2¼	Mh.23, Ap.3, 0.08
Tonopah Belmont	N. Y. Curb	*61	*61	*61	Mh.15, Ap.1 0.05
Tonopah Divide	N. Y. Curb			*23	Oct., 1923 0.10
Tonopah Extension	N. Y. Curb	2	1 13/16	2	Mh.11, Ap.1, Q 0.05
Tonopah Mining	N. Y. Curb	4	3¾	4	Mh.31, Ap.21, 0.07½
Unity Gold	N. Y. Curb	*80	*70	*80	
West End Consol.	N. Y. Curb	25	25	*25	Mar., 1923 0.05
Yukon Gold	N. Y. Curb			*50	June, 1918 0.02

Stock	Exch.	High	Low	Last	Last Div.
SILVER					
Alvarado	Boston Curb			*50	Oct. 1920 0.50
Beaver Consol	Toronto	*28	*27½	*27½	May, 1920 0.03
Castle-Trethewey	Toronto	*76½	*75½	*76	
Coniagas	Toronto	1.59	1.50	1.50	May, 1924 0.12½
Keeley	Toronto	1.84	1.79	1.81	Mh.1, Mh.15SA0.12
Kerr Lake	N. Y. Curb	1¾	*88	1¼	Ap.1, Ap.15, Q 0.12½
La Rose	Toronto	*48	*46½	*47	Apr., 1922 0.10½
Lorrain Trout Lake	Toronto			1.05	Ap. 15, 25 0 05
McKinley-Dar.-Sav.	Toronto	*28	*27¼	*27½	Oct., 1920 0.03
Mining Corp. Can.	Toronto	2.40	2.36	2.39	Sept., 1919 0.12½
Nipissing	N. Y. Curb	5	4¾	4¾	Mh.31, Ap.21 0.15
Ontario Silver	New York			6¼	Jan., 1919 0.50
Temiskaming	Toronto	*17	*17	*17	Jan., 1920 0.40
SILVER-LEAD					
Ahumada	New York	12¾	11¾	12¼	Jn.15, Jy.2, Q 0 07½
Bingham Mines	Boston	31¾	30¾	31¾	Jn.20, Jn.30 Q 0.50
Cardiff M. & M.	Salt Lake	1.37½	1.27½	1.30	De.16, No.18 0.10
Chief Consol	Salt Lake	3.75	3.75	3.75	Ap. 10, My. 1 0.10
Columbus Rexall	Salt Lake	*11	*10¾	*10¾	Aug., 1923 0.05
Erupcion	Boston Curb	3¼	3 1/16	3 1/16	Jn.15, Jy.2, Q 0.07½
Federal M. & S.	New York	17	16¼	16¼	Fe.26. Mh.15 Q1.75
Federal M. & S. pfd.	New York	55¾	53	55	My.25, Jn.15,Q 1.75
Hecla Mining	New York	14¾	14¼	14¼	Jn.15, Jy.1 Q 0.75
Iron Blossom Con.	Salt Lake			*39	Oc.25, 1924 0.01½
Iron King Mining	Salt Lake	*86	*74	*79	
Keystone Mining	Salt Lake	*78	*77	*77	
Mammoth Mining	Salt Lake	2 47½	2 30	2.37½	My.15 My.25 0.10
Marsh Mines	N. Y. Curb			*4	June, 1921 0.02½
Park City	Salt Lake	4.87½	4.75	4.85	Jn.15, Jy.1 Q 0.15
Park Utah	Salt Lake	4.72½	4.50	4.72½	April. 1924 0.15
Prince Consol	Salt Lake	*30	*23½	*30	
Silver King Coal	Salt Lake	7.40	7.10	7.40	Mh.20,Ap.1, Q 0.20
Silversmith	Spokane	*21½	*21	*21½	Ap.1, Ap.10 0.01
Tamarack-Custer	Spokane	*74	*66	*66	Sept, 1924 0 25
Tintic Standard	Salt Lake	10.00	9.95	10.00	Mh.23, Mh.30 0.40
Utah-Apex	Boston	7	6¾	6¾	Ap.5, Ap.15, 0.35
Western Utah Copper	N. Y. Curb			*14	
IRON					
Bethlehem Steel	New York	41	40	40	July, 1924 1.25
Char. Iron	Detroit			*20	
Char. Iron pfd.	Detroit			*85	
Colorado Fuel & Iron	New York	39¾	38	38½	May, 1921 0.75
Gt. North'n Iron Ore	New York	68½	66½	67¼	Ap.11, Ap.30 1.00
Inland Steel	New York	41¾	41	41¾	My.15, Jn.1 0.62½
Mesabi Iron	N. Y. Curb			2¾	
Replogle Steel	New York	15¼	14¾	15	
Republic I. & S.	New York	47¾	46	46	May, 1921 1.50
Republic I. & S. pfd.	New York	87	87	87	Jn.17, Jy.1, Q 1.75
Sloss-Sheffield S. & I.	New York	88½	87	87½	Jn.10, Jn.20 Q 1.50
Sloss-Shef. S.&I. pfd.	New York	93	92¾	93	Jn.20, Jy.1, Q 1.75
U. S. Steel	New York	118¾	115¾	116¾	Jn.1, Jn.29, QX 1. 5
U. S. Steel pfd.	New York	125	124¾	124¾	My.5, My 29,Q 1.75
Virginia I. C. & C.	New York			35	Jan., 1924 1.50
Virginia I.C.&C.pfd.	New York			75	De.13, Ja.2, SA 2.50
VANADIUM					
Vanadium Corp.	New York	30¼	28¼	28¾	Jan., 1921 1.00
ASBESTOS					
Asbestos Corp.	Montreal	81	73	78	My.1, My.15 Q 1.00
Asbestos Corp., pfd.	Montreal	111¼	104	109¼	Ap. 1, Ap. 15, Q 1.50
SULPHUR					
Freeport Texas	New York	16¾	14¼	16¼	Nov., 1919 1.00
Texas Gulf	New York	111	107¼	110¾	Jn.1, Jn.15, Q 1.75
DIAMONDS					
De Beers Consol	New York	21¼	21¼	21¼	Ja.6, Fe.2 0.95
PLATINUM					
So. Am. Gold & P.	N. Y. Curb	2¼	2¼	2¼	
MINING, SMELTING AND REFINING					
Amer. Metal	New York	48	47¼	48	My.19, Jn.1, Q 0.75
Amer. Metal pfd.	New York			113	My.20, Jn.1, Q 1.75
Amer. Sm. & Ref.	New York	102¼	98	101¼	Ap.13, My.4, Q 1.50
Amer.Sm.&Ref.pfd.	New York	112	108¼	108¼	My.8, Jn.1 Q 1.75
Consol. M. & S.	Montreal	85¾	77	83¼	De.11, Ja.15 SA 0.75
Federated Metals	N. Y. Curb	32	31¼	31¼	
Southwest Metals	N. Y. Curb			*80	
U. S. Sm. R. & M.	New York	36¼	36	36¼	Ap.6, Ap.15 0.75
U.S. Sm. R.&M.pfd.	New York	44¾	44¼	44¼	April. 1925 0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange and George H. Watson & Co.; Colorado Springs, Colorado Springs Stock Exchange.

LONDON QUOTATIONS, WEEK ENDED MAY 16

	High	Low	Last	Date	Per Cent
Aramayo Mines	77/9	76/3	77/6	May 1925	5(c)
British Platinum	8/9	6/10½	7/—	Feb. 1925	2½
Bwana M'Kubwa	5/9	5/6	5/9		
Camp Bird	3/—	2/6	2/10½		
El Oro	6/6	5/9	6/3	Nov. 1924	2½*
Esperanza	1/—	—/10½	—/10½		
Frontino & Bolivia	12/—	11/6	11/9	1923–24	10
Mexican Corporation	13/—	12/6	13/—		
Mexico Mines of El Oro	65/—	60/7½	63/9	Dec. 1924	25*
Nechi (pref. 10s.)	1/6	1/3	1/4½	1921–22	25
Oroville Dredging	8/7½	7/10½	8/3	Dec. 1923	3¾
Ouro Preto	5/9	5/6	5/7½	May 1925	2½
St. John del Rey	17/6	17/—	17/3	Dec. 1924	3¾(a)
San Francisco Mines	25/9	24/9	25/—	June 1925	15
Santa Gertrudis	11/7½	9/6	10/9	July 1920	5
Selukwe (2s. 6d.)	17/—	15/6	15/7½	April 1917	6¾
S. American Copper	8/6	7/10½	8/—	Nov. 1917	75
Tanganyika	30/—	27/6	28/1½		
Tomboy	4/—	3/9	4/—	Feb. 1925	4½
Union Minière du Haut-Katanga (Brussels)	100 fr. 5 150	4 945	5 150	July 1924	80(b)

* Free of British Income Tax. (a) Dividend of 6¼ p. c. to be paid June 26, 1925. (b) Belgian francs. (c) Swiss francs.